ATTACHMENT C

GROUNDWATER/LEAK DETECTION AND LEACHATE MONITORING PLAN

GROUNDWATER/LEAK DETECTION AND LEACHATE MONITORING PLAN

ON-SITE DISPOSAL FACILITY

JULY 2004

United States Department of Energy

20100-PL-009
Revision 1, Draft

SUMMARY OF PROPOSED TECHNICAL CHANGES TO THE OSDF GWLMP, REVISION 1, JULY 2004

Section/Figure	Description of Proposed Change	Driver/Technical Information
Global	The Fernald Environmental Management Project (FEMP) has been renamed to the Fernald Closure Project (FCP). The FEMP has been referred to as the Fernald site.	The name of the site has been changed to "Closure Project" to better reflect the cleanup mission. For consistency, the references to FEMP have been updated to the Fernald site.
Global	Specifications regarding the OSDF have been updated to reflect current information (e.g., cell dimensions, number of cells, references to "sump" have been updated liner penetration box, which is consider to be the most likely location for a potential leak to originate).	The previous revision of the plan was written in 1997 and cell specifications have been updated in various approved design documents.
Global (e.g., Section 1.4, References)	Referenced plans have been updated to reflect current information.	The previous revision of the plan was written in 1997. Since that time, many documents related to this plan have been written or updated.
Global (e.g., Sections 2.3 and 2.4) – eliminated Figure 4-5 from Revision 0	The previous revision reflected the Plant 6 groundwater remediation effort. As this is no longer planned, text has been updated to reflect this information. Eliminated Figure 4-5 from Revision 0: Plant 6 Pumping Scenario	The previous concentration levels of uranium in the Plant 6 have decreased; therefore, groundwater remediation in this area in no longer planned, as approved by OEPA and EPA.
Global (e.g., Section 3.0, Appendix A, and Section 5.2)	ARARs and other regulatory requirements were reviewed to determine if there were any necessary updates. Minimal changes were necessary. Examples of updates include: • Section 3.1 and Appendix A of Revision 0 referenced DOE Order 5820.2A which has been replaced by DOE Order 435.1. • Section 3.2.2 add PCBs to and remove chemical oxygen demand from the annual sampling of leachate (per OAC 3745-27-10 & 19) • Section 5.2 of Revision 0 referred to proposed OEPA Policy DDAGW-04-03-221 which has been revised to OAC 3745-27-10(D)(2)	Text has been updated where necessary to reflect current/accurate regulatory references. Primarily, the update has occurred for the following reason: It has been necessary to update the annual list for leachate sampling based on revisions to the OACs, which occurred during 2003. Specifically from review of the OACs (rule 3745-27-19), it has been identified that aroclors-1242, 1254, 1221, 1232, 1248, 1260, and 1016 need to be added to annual LCS sampling, and from OAC Appendix I of rule 3745-27-10 that chemical oxygen demand can be removed. These changes have been implemented with the 2004 annual sampling effort (Documented through the June 7, 2004 conference call between DOE, EPA, and OEPA).

SUMMARY OF PROPOSED TECHNICAL CHANGES TO THE OSDF GWLMP, REVISION 1, JULY 2004
(Continued)

Section/Figure	Description of Proposed Change	Driver/Technical Information
Section 3.2.1	The recommendation has been included in the plan that after each cell is capped, monitoring for each of the four components (i.e., LCS, LDS, horizontal till well, and Great Miami Aquifer wells) for the site-specific leak detection indicator parameters should be performed on a semiannual basis to continue to meet regulatory requirements.	The Ohio Solid Waste regulations require a semiannual sampling frequency for detection monitoring but also allow for the proposal of an alternate sampling program (OAC 3745-27-10(D)(5)(a)(ii)*(b)* and (b)(ii)*(b)*, and 3745-27-10(D)(6)). During active cell operations (more specifically post-baseline monitoring prior to cell capping), the sampling frequency for the OSDF groundwater/leak detection monitoring program will be quarterly for the indicator parameters, which exceeds the semiannual frequency requirement. After each cell is capped, it is planned that monitoring for each of the four components (i.e., LCS, LDS, horizontal till well, and Great Miami Aquifer wells) for the site-specific leak detection indicator parameters will be done on a semiannual basis to continue to meet regulatory requirements. Upon approval from EPA and OEPA, the semiannual frequency will be implemented, through a variance to the project-specific plan (PSP) provided in Appendix B. This frequency would be implemented for Cells 1, 2, and 3 which have been capped.
Section 4.0 Reorganization	Section 4.0 was slightly reorganized (Section 4.4 has become Section 4.5 and Section 4.5 has become Section 4.4) to allow for a more logical discussion of monitoring. Section 4.4 now identifies the parameter selection process and Section 4.5 identifies the sample collection process for baseline and post-baseline monitoring.	Reorganization allows for a more logical discussion of monitoring. It is important to note that the overall parameter selection process that was established and approved in Revision 0 has not been altered. Minor updates to monitoring parameters have been made based on OAC updates and on technical knowledge obtained from the 7+ years of monitoring the OSDF.

SUMMARY OF PROPOSED TECHNICAL CHANGES TO THE OSDF GWLMP, REVISION 1, JULY 2004
(Continued)

Section/Figure	Description of Proposed Change	Driver/Technical Information
Deletion of sections from Revision 0: Section 4.3.4.1 Section 4.4.3 Section 5.1.2	Delete the following sections: Section 4.3.4.1 Influence of Aquifer Restoration Activities Section 4.4.3 Future Considerations Section 5.1.2 Monitoring Needs	Section 4.3.4.1 was eliminated because the previous concentration levels of uranium in Plant 6 have decreased; therefore, groundwater remediation in this area is no longer planned, as approved by OEPA and EPA. Section 4.4.3 was removed to eliminate redundancy. Monitoring frequencies to be used during baseline and post-baseline monitoring are identified in Appendix B. Section 5.1.2 was eliminated because in the previous revision, it was identified that in order to ensure the Fernald site's NPDES permit conditions associated with the effluent from the treatment facility are met, and to ensure that introduction of the leachate as a wastestream does not interrupt or affect the proper operation of the facility, that select analytical parameters for the leachate would be monitored after leachate collection and prior to treatment. Specifically, four parameters were identified as requiring analysis to ensure that the leachate does not detrimentally affect the treatment system – pH, TOC, nitrate/nitrite, and total dissolved solids (TDS). With the 7+ years of data collected, there has been no impact and no impact is expected in the future. The constituents will continue to be monitored: pH and TOC are site-specific leak detection indicator parameters; however, it is recommended that nitrate/nitrite and TDS, which are monitored quarterly in each cell's LCS, be monitored annually as they are per OAC 3745-27-10 & 19 Appendix I constituents. Upon approval from EPA and OEPA, nitrate/nitrite and TDS monitoring will be performed annually. A variance to the PSP provided in Appendix B will be written to implement this proposed change.
Eliminated Figure 4-3 from Revision 0	Eliminated Figure 4-3 from Revision 0: Horizontal Till Well Cross Section Instead of including a figure a reference was added in Section 1.0 of Revision 1: (Refer to Plates G-32: Liner System Details and G-44: Horizontal Till Wells and Miscellaneous Details from the January 2004 OSDF Phase V Construction Drawing Package.)	Construction drawing plates are provided to EPA and OEPA and contain a great deal of detail. Figures are not easily reproducible for inclusion in reports/plans.

SUMMARY OF PROPOSED TECHNICAL CHANGES TO THE OSDF GWLMP, REVISION 1, JULY 2004
(Continued)

Section/Figure	Description of Proposed Change	Driver/Technical Information
Section 4.3.4.1	Revision 1, Section 4.3.4.1 Siting of the Great Miami Aquifer Monitoring Wells: In Revision 0, 20 wells were proposed for monitoring based on nine cells. For Revision 1, 18 wells have been proposed for monitoring based on eight cells.	The wells have been reduced from 20 to 18 based on the reduction in cells (i.e., 9 to 8).
Section 4.3.4.2 (Figure 4-3)	In the previous revision, modeling was performed using the SWIFT modeling code. The current groundwater model code VAM3D . The VAM3D flow model results are similar to the flow modeling results previously obtained with the SWIFT groundwater model. Monitoring wells for Cells 1 through 3 were placed based on the results from the SWIFT groundwater flow model (provided in Revision 0 of this plan) and monitoring wells from Cells 4 through 8 were placed based on the results from the VAM3D flow model. Since the modeling results were so similar Figures 4-4 and 4-5 were not updated. Note: Figure 4-3 Post Remediation Scenario has changes based on VAM3D modeling and therefore has been updated.	It is necessary to use the most current groundwater model. Note that the VAM3D flow model results are similar to the flow modeling results previously obtained with the SWIFT groundwater model from the previous revision.
Appendix B through D	Replaced Revision 0 Appendix B: Sampling and Analysis Requirements Appendix C: Quality Assurance/Quality Control Appendix D: Data Management Plan With Appendix B and Appendix C: the PSP and Data Quality Objectives (DQO)	The PSP and DQO contain the same information that was in the previous appendices. The PSP and DQO are used by the field technicians. By replacing the other appendices from Revision 0 with the PSP and DQO, redundancy is eliminated.
Appendix B	Revision 1: Appendix B includes all the monitoring updates that have been approved by the EPA and OEPA per the technical memorandum for Cells 1 through 3, per annual site environmental reports, through weekly conference calls and per variances.	Updates to monitoring need to be reflected in the PSP.

GROUNDWATER/LEAK DETECTION AND LEACHATE MONITORING PLAN

ON-SITE DISPOSAL FACILITY

JULY 2004

United States Department of Energy

Draft, Revision 1

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ARARs	applicable or relevant and appropriate requirements
AWWT	advanced wastewater treatment facility
CAWWT	converted advanced wastewater treatment facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm/sec	centimeters per second
COC	constituent of concern
CPTs	cone penetrometer tests
D&D	decontamination and demolition
DOE	U.S. Department of Energy
EPLTS	Enhanced Permanent Leachate Transmission System
EPA	U.S. Environmental Protection Agency
FCP	Fernald Closure Project
FRL	final remediation level
FS	feasibility study
gpm	gallons per minute
HDPE	high-density polyethylene
HTQ	horizontal till well
IEMP	Integrated Environmental Monitoring Plan
LCS	leachate collection system
LDS	leak detection system
µg/L	micrograms per liter
mg/kg	milligrams per kilograms
mg/L	milligrams per liter
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OSDF	on-site disposal facility
PCBs	polychorinated biphenyls
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
PCS	permanent lift station
RA	remedial action
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SCQ	Sitewide CERCLA Quality Assurance Project Plan
SDWA	Safe Drinking Water Act
SWIFT	Sandia Waste Isolation Flow and Transport
TOC	total organic carbon
TOX	total organic halogens
UMTRCA	Uranium Mill Tailings Radiation Control Act
VAM3D	Variably Saturated Analysis Model in 3 Dimensions
WAC	Waste Acceptance Criteria

1.0 INTRODUCTION

This document presents the groundwater/leak detection and leachate management monitoring program for the on-site disposal facility (OSDF) at the U. S. Department of Energy's (DOE's) Fernald Closure Project (FCP). This plan is a support plan for the OSDF that is required by the Remedial Action (RA) Work Plan for the OSDF (DOE 1996). Revision 0 of this plan was issued in August 1997 (DOE 1997). Revision 1 is being issued at this time due to the:

- Completion and approval by the U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (OEPA) of the Technical Memorandum for the On-Site Disposal Facility Cells 1, 2, and 3 Baseline Groundwater Conditions (DOE 2002)
- Experience/technical knowledge gained over the last 7+ years of monitoring and operating under Revision 0
- Inclusion of this plan in the Legacy Management and Institutional Control Plan (DOE 2004a).

As is discussed in detail in this document, the monitoring program is comprised of two primary elements: (1) a leak detection component, which provides information to verify the ongoing performance and integrity of the OSDF and its impact on groundwater; and (2) a leachate monitoring component, which satisfies regulatory requirements for leachate collection and management. The leak-detection monitoring layers (comprised of a leak detection layer inside the facility, and two groundwater zones occurring in the subsurface below the facility) will be used collectively to assess the existence of leakage from the facility and to satisfy OSDF groundwater monitoring requirements. The two groundwater zones in the monitoring plan are the Great Miami Aquifer (a water table found at depths ranging from 40 to 90 feet in the vicinity of the OSDF), and the perched groundwater residing in the glacial till overlying the Great Miami Aquifer.

This OSDF monitoring plan has been developed to meet the regulatory requirements for groundwater detection monitoring in both the Great Miami Aquifer and the perched groundwater system. These detection monitoring requirements constitute the first tier of a three-tiered detection, assessment, and corrective action monitoring strategy required for engineered disposal facilities. Consistent with this three-tiered requirement, if it is determined from detection monitoring that a leachate leak from the OSDF into the underlying natural hydrogeologic environment has occurred, follow-up groundwater quality assessment and corrective action monitoring plans will be developed and implemented as necessary. Conversely, if the detection monitoring continues to successfully demonstrate that leachate leaks are not of concern (i.e., the facility is performing as designed), then the monitoring program will remain in the first-tier "detection mode" and the need for the follow-up groundwater quality assessment and/or corrective action monitoring plans will not be triggered.

1.1 OVERVIEW OF THE ON-SITE DISPOSAL FACILITY

The OSDF will ultimately provide on-site disposal capacity for an estimated 2.9 million cubic yards of contaminated soil and debris generated through the Fernald site's environmental restoration and building decontamination and demolition (D&D) activities. The OSDF footprint (including the capped area extending beyond the disposal area) is anticipated to occupy approximately 80 acres of the 1050-acre Fernald site. This area will be dedicated to disposal and will remain under federal administrative control following the completion of the Fernald site's cleanup mission. The OSDF is located along the northeast portion of the Fernald site and, as required by the Operable Unit 2, 3, and 5 Records of Decision, is situated over the "best available geology" at the Fernald site to take maximum advantage of the protective hydrogeologic features of the glacial till above the Great Miami Aquifer.

The OSDF is being constructed in phases, with eight individual cells planned, plus a ninth contingency cell, if needed. Each individual cell is planned to be 700 feet by 400 feet, or 280,000 square feet (6.4 acres). Each individual cell is being constructed with a leachate collection system (LCS) to collect infiltrating rainwater (and storm water runoff during waste placement) and prevent it from entering the underlying environment. Other engineered features include a multi-layer composite liner system; a leak detection system (LDS) positioned beneath the primary liner; and a multi-layer composite cover placed over each cell following the completion of waste placement activities. The LCS and LDS layers drain to the west to a point where the collected fluids will be removed from each layer for treatment (henceforth, these LCS and LDS collection points will be referred to as the liner penetration box). The liner penetration box is the point where the LCS and LDS pipes penetrate the liner system and therefore represents the lowest elevation area of each cell. Since the liner penetration boxes exist the cells at the lowest area of the liner system, they are the most likely location for a potential leak to originate. (Refer to Plates G-32: Liner System Details and G-44: Horizontal Till Wells and Miscellaneous Details from the January 2004 OSDF Phase V Construction Drawing Package.)

1.2 PROGRAM OVERVIEW

The OSDF monitoring plan was developed by reviewing the pertinent regulatory requirements for detection monitoring and translating those requirements into site-specific monitoring elements (e.g., designation of monitoring zones, monitoring station locations, sampling frequency, and establishment of analytical parameters). As the remaining sections of this plan will discuss, the OSDF monitoring strategy is responsive to monitoring needs both during the active remediation of the site and during the post-remediation period when restoration activities at the Fernald site are complete. Similarly, the strategy recognizes the various operating phases of the OSDF including the periods before, during, and after waste placement when the final cap is in place, at which point the facility will enter a long-term post-closure care mode.

The plan also considers current hydrogeologic and contaminant conditions in the glacial till and Great Miami Aquifer beneath the facility. Pre-existing contamination in the perched groundwater system and the Great Miami Aquifer, the variable nature of the geology and hydrogeology of the clay-rich glacial deposits, and the influence of aquifer restoration activities in the Great Miami Aquifer add complexity to the development of a groundwater monitoring program. The Great Miami Aquifer will be undergoing restoration during the same overall time period that the OSDF will be actively accepting waste for disposal. The aquifer restoration is a pump-and-treat operation. The closest pumping wells are approximately 2,000 feet upgradient of the OSDF footprint.

Available site-specific information that has been generated from more than 15 years of detailed site characterization efforts including geology and hydrogeology, results of detailed contaminant fate and transport modeling, OSDF construction activities, and monitoring results from the OSDF program and Integrated Environmental Monitoring Plan (IEMP) all were used to develop the monitoring strategy and to determine monitoring locations. The overall strategy employs a four-layer vertical slice/trend analysis approach to independently monitor the potential for leachate generation and leakage from each of the individual disposal cells comprising the facility. As part of this strategy, "baseline" conditions for each cell is being established to facilitate trend analysis from data generated for each of the monitoring stations over time. This baseline will help define existing conditions in both the perched groundwater and the Great Miami Aquifer in the immediate vicinity of the facility.

This plan focuses primarily on the monitoring needs associated with active cell operations and detection monitoring or post-closure monitoring. Future amendments to the plan will be prepared to address program modifications, if changes to the monitoring program are necessary. An in-depth review of program needs is also envisioned at the completion of Great Miami Aquifer restoration activities. Prior to the closure of the cells and the completion of the aquifer restoration activities, the data comparisons will focus on shorter term "interim" leakage effects that might potentially occur during active cell operations. The initial baseline will enhance the ability to conduct the interim comparisons until the facility enters its final long-term, post-closure mode and aquifer restoration activities are complete.

Throughout this process, the analytical results and trend analyses for all three leak detection monitoring layers (the LDS, perched groundwater, and the Great Miami Aquifer) and the LCS will be compared with one another to evaluate the overall performance of each cell and to determine whether a release from the facility has occurred. In concert with the groundwater monitoring component of the program, the leachate characterization and tracking component will provide for the monitoring of leachate concentrations and flows in the LCS and LDS to support leachate management and treatment decisions.

As part of this effort, contaminant concentrations in the leachate (if present) collected from the LCS and the water from the LDS (if present) will be compared to one another and to the groundwater concentrations in the perched groundwater and Great Miami Aquifer monitoring systems. Additionally, trend analysis of the LCS and LDS flow monitoring measurements will be conducted in order to provide an indication of changes in trends in containment system performance far enough in advance to allow application of appropriate follow-up inspection and corrective action measures as necessary.

During the development of this plan, EPA and OEPA identified the need to monitor the potential for leachate leakage from the OSDF at its first point of entry into the natural hydrogeologic environment (rather than relying on Great Miami Aquifer groundwater monitoring alone). This led to the decision to install horizontal monitoring wells in the glacial till directly beneath the liner penetration box of the LCS and LDS layers in each cell. The subsurface area beneath the liner penetration box provides the best opportunity to monitor for an initial leak into the subsurface environment, should such a leak occur. As a result of the low transmissive properties of the glacial till and the discontinuous nature of the perched groundwater system in the till, it may not be possible to collect fluids routinely from the horizontal wells. In view of this limitation, DOE, EPA, and OEPA concurred that the placement of the horizontal wells beneath the liner penetration boxes represents the most feasible site-specific approach to monitor for first-entry leakage from the facility to the environment, and this approach provides adequate and appropriate early warning detection capabilities for this site-specific setting.

The OSDF groundwater monitoring plan has been implemented as a project-specific plan (refer to Appendix B), with the results presented for EPA and OEPA review as part of the comprehensive IEMP. The IEMP provides a consolidated reporting mechanism for all of the individual environmental regulatory compliance monitoring activities including the data and findings from the OSDF groundwater monitoring plan. Incorporating the OSDF data into the IEMP will maintain the continued commitment to an effective remediation-focused environmental surveillance monitoring program. Once the environmental remediation requirements have been completed and the site is successfully removed from the Superfund National Priorities List (NPL), the monitoring activity for the OSDF (which will be the last remaining facility in place at the site) will continue in accordance with applicable regulatory monitoring and reporting requirements.

1.3 PLAN ORGANIZATION

The remainder of this plan is organized as follows:

- A summary of the geology and hydrogeology in the immediate area of the OSDF is provided in Section 2.0.
- A regulatory analysis and strategy for OSDF monitoring is provided in Section 3.0.
- The OSDF leak detection monitoring program is provided in Section 4.0, including a description of program elements, monitoring frequencies, selection of analytical parameters, and data evaluation.
- The OSDF leachate management monitoring program, which will be used to support leachate management decisions, is provided in Section 5.0.
- Reporting requirements and notifications are provided in Section 6.0.
- References are provided in Section 7.0.

The appendices that support the plan are:

- Appendix A – OSDF Applicable or Relevant and Appropriate Requirements (ARARs) and Other Regulatory Requirements
- Appendix B – Project-Specific Plan for the On-Site Disposal Facility Monitoring Program
- Appendix C – Fernald Closure Project Data Quality Objectives, Monitoring Program for the On-Site Disposal Facility Program

1.4 RELATED PLANS

Several other remedial action plans have been prepared for the OSDF, or for the Fernald site as a whole, containing information relevant to this plan. These other plans are listed below along with a brief statement of their relationship to this plan:

- OSDF Systems Plan (DOE 2001b): describes the inspection and maintenance for the LCS and LDS prior to closure of the OSDF.
- OSDF Design Package (GeoSyntec 1996a/b) and subsequent design and construction drawing packages: provide the overall approved design for each cell of the OSDF.
- OSDF Post-Closure Care and Inspection Plan (DOE 2004b): describes the post closure care and inspection for the LCS and LDS, and summarizes at the conceptual level corrective actions/response actions.
- OSDF Borrow Area Management and Restoration Plan (GeoSyntec 2001a): describes management of borrow soils for use to construct the OSDF and planning for end state after soils have been excavated.

- OSDF Surface Water Management and Erosion Control Plan (GeoSyntec 2001c): describes soil erosion control to minimize sediment loss.

- OSDF Construction Quality Assurance Plan (GeoSyntec 2001b): describes quality assurance methods and testing to certify the construction of the OSDF.

- OSDF Impacted Materials Placement Plan (GeoSyntec 2004): describes the categories of material, prohibited items, and placement methods for impacted material placement in the cells.

- Project- Specific Plan for Installation of the OSDF Great Miami Aquifer Wells (DOE 2001a): describes the installation placement of Great Miami Aquifer wells.

- Technical Memorandum for the OSDF Cells 1, 2, and 3 Baseline Groundwater Conditions (DOE 2002): describes baseline conditions for Cells 1, 2, and 3.

- IEMP, Revision 3 (DOE 2003a): describes Fernald site environmental monitoring efforts and the requirements for reporting on environmental monitoring, including the data collected from this OSDF monitoring program.

2.0 OSDF AREA GEOLOGY AND HYDROGEOLOGY

2.1 INTRODUCTION

The Operable Units 2, 3, and 5 Records of Decision contain requirements that the OSDF be located in an area at the Fernald site that takes maximum advantage of available geologic and hydrogeologic conditions to further reduce the potential for contaminant migration from the facility. To identify the preferred OSDF location, a detailed predesign geotechnical and hydrogeologic investigation was conducted as a supplement to the sitewide characterization efforts contained in the Operable Unit 5 Remedial Investigation (RI) Report (DOE 1995c). The detailed findings of the predesign investigation are documented in the Pre-Design Investigation and Site Selection Report for the OSDF (DOE 1995b). As documented in the site selection report, a final site location along the eastern margin of the Fernald site was selected to satisfy the Records of Decision and other regulatory-based siting requirements.

The following sections summarize the principal geologic, hydrogeologic, and subsurface contaminant conditions in the OSDF site area that have a direct bearing on the development of the leak detection and groundwater monitoring strategy for the facility. For more detailed information, the reader is referred to the Predesign Investigation and Site Selection Report and the Operable Unit 5 RI Report.

2.2 OSDF AREA GEOLOGY

The OSDF, inclusive of its final cap configuration, is expected to occupy an area of approximately 80 acres along the northeastern area of the Fernald site. The facility is oriented in a north-to-south direction with ultimate dimensions at closure expected to be 3600 feet by 1000 feet. The edge of the facility (i.e., the toe of the cap system) is set back from the eastern property line by approximately 100 feet. The subsurface conditions in the immediate area of the selected OSDF location were characterized through the following field and laboratory activities:

Test Borings	Fifty-four borings were drilled in the immediate vicinity of the OSDF to obtain geotechnical soil samples and characterize underlying geology.
Monitoring Wells	Fifty-one groundwater monitoring wells were installed in the general vicinity of the OSDF from which water level, pre-existing groundwater contaminant concentration data, and lithology data have been obtained.
Geotechnical Tests	Key geotechnical tests (i.e., Atterberg limits, water content measurements, and permeability tests) were performed on subsurface geologic samples, including 116 sieve analyses to determine grain size.

Lysimeter Installation	Eight lysimeters were installed in the OSDF site area to determine the nature and concentration of uranium in the vadose zone of the glacial till and the unsaturated Great Miami Aquifer.
Slug Tests	Twenty-four slug tests were performed to assess the hydraulic characteristics of the perched groundwater system.
Water Level Monitoring	Water levels obtained from the perched groundwater and the Great Miami Aquifer wells were used to determine hydraulic gradients and flow directions.
Soil Analyses	Soil samples collected during the RI and the Predesign Investigation were analyzed for uranium and other constituents of concern to determine pre-existing contaminant levels in the subsurface beneath the OSDF.
Groundwater Flowmeter Study	Twenty-two flowmeter readings were obtained in the perched groundwater in the OSDF site area.
K_d Study	A distribution coefficient (K_d) study was performed to determine how uranium will partition itself between groundwater and soil in the OSDF site area.
Cone Penetrometer Tests (CPTs)	Eighty-eight CPTs were conducted in the OSDF site area to aid in making subsurface lithologic interpretations.

The information obtained through these activities, coupled with the sitewide interpretations gained through the Operable Unit 5 RI, formed the basis for the interpretations of subsurface conditions in the vicinity of the OSDF site.

In general, the OSDF site is situated on glacial till underlain by sand and gravel deposits that comprise the Great Miami Aquifer, which is designated as a sole-source aquifer under the Safe Drinking Water Act (SDWA). The Great Miami Aquifer is a high-yield aquifer (i.e., wells completed in some areas of the aquifer yield greater than 500 gallons of water per minute) and supplies a significant amount of potable and industrial water to people located in Butler and Hamilton counties.

The glacial till ranges in thickness from approximately 20 to 60 feet in the immediate vicinity of the OSDF. Based on the results of 116 sieve and hydrometer analyses, the glacial till can be characterized as a dense, heterogeneous sandy lean clay, with occasional discontinuous interbedded sand and gravel lenses. The glacial till can be further divided into an upper brown clay layer and a lower gray clay layer. The brown clay layer is more weathered, contains a greater abundance of desiccation fractures compared with the underlying gray clay layer, and has a higher incidence of interbedded sand and gravel lenses. In the eastern portions of the Fernald site, the gray clay ranges in thickness from approximately 15 to 42 feet, and the brown clay ranges from approximately 8 to 15 feet. As indicated by the Operable Unit 5

RI, the gray clay is the most uniform and least permeable and, therefore, the most protective geologic layer found above the Great Miami Aquifer across the site.

As a follow-up to the Operable Unit 5 RI, one of the primary objectives of the *Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility* was to identify the location where the thickest laterally persistent gray clay layer is present that contains the least amount of interbedded coarse granular material and which allows regulatory-based siting requirements (such as property-line and other geographic setbacks) to be met. The selected location for the OSDF has a minimum thickness of gray till of approximately 15 feet and an average thickness of approximately 30 feet. The percentage of interbedded sands and gravels in the gray till in this area is approximately 4 percent.

Beneath the glacial till layer, the sand and gravel deposits comprising the Great Miami Aquifer are approximately 175 feet thick. For RI characterization and monitoring purposes, the Great Miami Aquifer deposits have been divided into three geologic zones: the uppermost zone, represented by the Fernald site's Type 2 monitoring wells; the middle zone, represented by the Type 3 monitoring wells; and the lowermost zone, represented by the Type 4 monitoring wells. The sand and gravel deposits comprising the aquifer are extensive and, at the regional scale, occupy a land area of more than 970,000 acres.

Beneath the Great Miami Aquifer deposits, shale and limestone bedrock is encountered at a total depth of approximately 200 feet beneath the planned OSDF site. Regional studies by the Geological Survey of Ohio indicate the shale and limestone bedrock is approximately 330 feet thick in the Fernald site area (Fenneman 1916).

2.3 HYDROGEOLOGIC CONDITIONS

The Fernald site has two distinctive bodies of groundwater that have been extensively characterized through the remedial investigation/feasibility study (RI/FS) process and the Predesign Investigation: the Great Miami Aquifer and the perched groundwater found within the overlying glacial till. The discontinuous sand and sand/gravel lenses found within the glacial till can provide water to a pumping well because the deposits are more permeable than the surrounding, clay-rich glacial till. The entire section of glacial till is believed to be saturated or nearly saturated with groundwater. An unsaturated sand and gravel zone approximately 20 to 30 feet thick separates the base of the glacial till from the regional water table in the Great Miami Aquifer. Depending on local weather patterns and rainfall, the water table in the Great Miami Aquifer fluctuates approximately 6 feet yearly within the unsaturated zone separating the two groundwater systems in the area of the OSDF.

The Great Miami Aquifer is a classic example of an unconfined buried valley aquifer. The depth to water in the aquifer in the vicinity of the OSDF ranges from 40 to 90 feet below the ground surface. Based on five years of water level measurements collected prior to the beginning of the pump-and-treat remedy (1988 through 1993), the groundwater flow direction in the aquifer in this area is from west to east (Operable Unit 5 RI Report, Figure 3-50). Groundwater velocity in the area of the OSDF is approximately 451 feet per year, based on an average hydraulic gradient of approximately 0.0008 (Operable Unit 5 RI, page 3-61); an average hydraulic conductivity of approximately 463 feet per day (average of three pumping tests); and an effective porosity of 30 percent. Using the representative distribution coefficient (K_d) for uranium of 1.78 liters per kilogram determined through the RI/FS process, the retardation factor for uranium movement in the Great Miami Aquifer is approximately 12. At a retardation factor of 12, the uranium moves approximately 1/12 as fast as the water or approximately 37.6 feet per year. More recent studies conducted by Sandia National Laboratories indicate that the K_d is higher than 1.78. A higher K_d results in a higher retardation factor and indicates slower migration times.

Perched groundwater is present above the unsaturated zone of the Great Miami Aquifer within the glacial till. Overall the till exhibits between 90 to 100 percent saturation (close to field capacity) and has the general properties of an aquitard. When the till reaches field capacity, it has the capability to release groundwater downward under a unit vertical hydraulic gradient into the underlying unsaturated zone of the Great Miami Aquifer. Eventually, this downward-moving groundwater will enter the saturated portion of the Great Miami Aquifer as recharge. Depths to perched groundwater in the till are generally 6 feet or less in the eastern portion of the Fernald site in the area of the OSDF.

Although the till is generally saturated, there are no identified suitably thick or laterally continuous coarse-grained zones beneath the OSDF that can facilitate implementation of a comprehensive, interlinked (i.e., up- and downgradient monitoring points) perched groundwater monitoring system. The current amount of saturation in the till is expected to be reduced even further in the future, once the cap and underlying liners of the OSDF are in place; they will serve as local hydraulic barriers to further reduce the volume of infiltrating moisture within the OSDF footprint.

Slug test data from 24 perched groundwater wells (Type 1 monitoring wells) indicate that the average horizontal hydraulic conductivity for wells screened across the brown and gray clay layer interface is 6.30 x 10^{-6} centimeters per second (cm/sec). The gray clay layer beneath the brown clay is the least permeable layer above the Great Miami Aquifer. Laboratory hydraulic conductivities conducted on samples collected from this layer indicate measured values ranging from 9.53 x 10^{-9} cm/sec to 5.83 x 10^{-8} cm/sec. Other laboratory and field measurements indicate the till has an effective porosity of 4 to 10 percent, and a representative bulk density of 1.85 grams per cubic centimeter. The discontinuous nature of the perched water in the glacial till does not facilitate the measurement of a continuous water table gradient in the OSDF site area.

Model calibration studies conducted during the Operable Unit 5 RI/FS indicate average vertical groundwater flow rates through the glacial till (including the gray clay layer) to be approximately 6 inches per year. The time it takes a contaminant to move through the glacial till and break through into the Great Miami Aquifer is controlled by the thickness of gray clay present in the till, the groundwater infiltration rate through the gray clay, and the retardation properties of the gray clay. In the OSDF site area, modeled breakthrough travel times for uranium, the Fernald site's predominant contaminant, range from approximately 210 years (to have a 20 micrograms per liter [μg/L] concentration in the aquifer) to 260 years (to have 1 percent of the source concentration). These breakthrough times were calculated using a retardation factor of 165 for the gray clay, not taking any credit for movement through the brown clay, and not including any retardation in the unsaturated Great Miami Aquifer sand and gravel. The modeled breakthrough travel time for 1 percent of a technetium source, the Fernald site's most mobile contaminant, is approximately 3.6 years. This breakthrough time was calculated using a retardation factor of 2.29 for the gray clay, not taking any credit for movement through the brown clay, and not including any retardation in the unsaturated Great Miami Aquifer sand and gravel. This modeling strategy was used in the Operable Unit 5 Feasibility Study (FS) to calculate Waste Acceptance Criteria (WAC) for the OSDF.

The extensive presence of low permeability lean sandy clay throughout the till matrix and the discontinuous nature of the coarser grained lenses are the dominant factors controlling the rate at which fluids can migrate through the more permeable portions of till, either vertically or laterally.

Unlike conditions in the Great Miami Aquifer, the up- and downgradient directions of perched groundwater flow are difficult to assign at the local scale. Groundwater flow meter readings from 22 wells taken during the Predesign Investigation indicate that the horizontal flow directions vary abruptly from well to well, with no discernable consistent patterns. Consequently, horizontal flow regimes are interpreted to be very localized in nature (perhaps on the order of tens to hundreds of feet in length) and not laterally persistent due to the discontinuous nature of the interbedded coarse grained lenses. Taken collectively, the water levels obtained during the Operable Unit 5 RI indicate that if an area gradient were present, it would range from between 0.008 to 0.015.

Model calibration studies conducted during the Operable Unit 5 RI/FS indicate that vertical flow tends to dominate in the glacial till because of several factors: (1) the steep vertical hydraulic gradients across the till—which are at or near unity—compared to the small localized lateral hydraulic gradients which collectively indicate a gradient that is much less than unity (0.008 to 0.015); (2) the laterally discontinuous nature of the coarse grained lenses in the till; and (3) the shorter overall flowpath distance in the vertical dimension for the Fernald site (60 feet compared to hundreds or thousands of feet in the horizontal) before a potential discharge point for the glacial till groundwater is reached.

It can be generally interpreted from this information that if a leachate leak were able to exit through the OSDF liner system, it would be expected to migrate vertically towards the Great Miami Aquifer (although some localized "stair step" motion laterally may also be expected to take place in route). The exact pathway(s) that a hypothetical leachate leak from the facility would take is difficult to determine, but it is clear that an effective monitoring program needs to consider both the most likely point of entry of the leak into the subsurface environment beneath the facility and the ultimate arrival of the leak at the Great Miami Aquifer.

2.4 EXISTING CONTAMINATION

In the immediate vicinity of the OSDF, existing contaminant concentrations are present above background levels in surface and subsurface soil, the perched groundwater, and the Great Miami Aquifer. The nature and extent of contamination in these three media were documented in the Operable Unit 5 RI Report and preliminary remediation levels were developed for the FCP's environmental media in the Operable Unit 5 FS (DOE 1995a). Final remediation levels (FRLs) were documented in the Operable Unit 5 Record of Decision.

Based on the data presented in the Operable Unit 5 RI Report, only the surface soil (to a depth of approximately 6 inches) was considered to be contaminated above FRLs within the actual boundaries of the OSDF. The remaining media within the OSDF footprint were contaminated above background, but generally below FRLs. An area of deep soil excavation to address deep soil and perched groundwater contamination was completed outside the OSDF footprint at the Fernald site's sewage treatment plant, located immediately east of the OSDF. Additionally, in the spring of 2004 an area due west of Cell 8 was excavated to approximately 6 feet due to contamination just above the soil FRLs. This area was the closest excavation necessary to address soil FRL exceedances that were deeper than 6 inches.

The Plant 6 area is located approximately 300 feet west of the OSDF. During the remedial investigation, a uranium plume was detected in this area. Direct-push sampling conducted in 2000 and 2001, in support of the Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 areas, indicated that the uranium plume in the Plant 6 area was no longer present. It is believed that the uranium plume dissipated to concentrations below the FRL as a result of the shutdown of plant operations in the late 1980s and the pumping of highly contaminated perched water as part of the Perched Water Removal Action #1 in the early 1990s. Because a total uranium plume with concentrations above the groundwater FRL was no longer present in the Plant 6 area at the time of the design, a restoration module for the Plant 6 area became unnecessary and was no longer planned.

Continued routine groundwater monitoring for the IEMP in the Plant 6 area detected groundwater FRL exceedances for uranium in 2002 and the first part of 2003, but uranium concentrations once again dropped below the FRL in late 2003. Groundwater monitoring will continue as part of the IEMP and additional direct-push sampling is planned for the Plant 6 area. Sporadic and isolated detections of constituents above the FRLs in the Great Miami Aquifer are observed from time to time at the Fernald site's property boundary (located approximately 300 feet east of the OSDF), but these isolated detections are not considered to be part of a definitive plume requiring remediation. These detections will continue to be tracked as part of the IEMP sampling activities.

In accordance with the Operable Unit 5 Record of Decision, remedial actions for surface and subsurface soil, the perched groundwater in the glacial till, and the Great Miami Aquifer have been implemented in areas where FRLs have been exceeded. However, at the completion of the sitewide remedial actions, low levels of some contaminants (i.e., above background levels but below FRLs) are expected to remain in the various environmental media at the Fernald site, including the area adjacent to and beneath the OSDF. This residual low-level contamination that will remain after cleanup is recognized as a factor that creates a degree of uncertainty in the ability to distinguish small quantities of potential OSDF leakage from the pre-existing levels of contamination in the media. A strategy to accommodate this uncertainty factor in the development of the monitoring plan is provided in Section 4.0.

3.0 REGULATORY ANALYSIS AND STRATEGY

The OSDF groundwater/leak detection and leachate monitoring plan is designed to comply with all regulatory requirements associated with groundwater detection monitoring and leachate monitoring for disposal facilities. The source of these regulatory requirements is the ARARs listed in the Records of Decision for Operable Units 2, 3, and 5. This section summarizes the regulatory requirements by describing each ARAR, and presents the regulatory strategy for compliance with these ARARs.

3.1 REGULATORY ANALYSIS PROCESS AND RESULTS

The analysis of the regulatory drivers for groundwater monitoring for the OSDF was conducted by examining the suite of ARARs in the Fernald site's approved Operable Unit Records of Decision to identify a subset of specific groundwater monitoring requirements for on-site disposal facilities. Three Records of Decision (for Operable Units 2, 3, and 5) include requirements related to on-site disposal. The Records of Decision for these three operable units were reviewed and the ARARs relevant to the OSDF identified. The results of this review are provided in Appendix A and summarized below.

The following sets of regulations were identified as being ARARs for the OSDF groundwater monitoring program:

- Ohio Solid Waste Disposal Facility Groundwater Monitoring Rules, Ohio Administrative Code (OAC) 3745-27-10, which specify groundwater monitoring program requirements for sanitary landfills. These regulations describe a three-tiered program for detection, assessment, and corrective measures monitoring.

- Resource Conservation and Recovery Act (RCRA)/Ohio Hazardous Waste Groundwater Monitoring Requirements for Regulated Units, 40 Code of Federal Regulations (CFR) 264.90 through .99 (OAC 3745-54-90 through 99), which specify groundwater monitoring program requirements for surface impoundments, landfills, and land treatment units that manage hazardous wastes. Similar to the Ohio Solid Waste regulations, these regulations describe a three-tiered program of detection, compliance, and corrective action monitoring. Because the Ohio regulations mirror or are more stringent than the federal regulations, the Ohio regulations are the controlling requirements and are cited within this document.

- Uranium Mill Tailings Reclamation and Control Act (UMTRCA) Regulations, 40 CFR 192.32(A)(2), which specify standards for uranium byproduct materials in piles or impoundments. This regulation requires conformance with the RCRA groundwater monitoring performance standard in 40 CFR 264.92. Compliance with RCRA/Ohio Hazardous Waste regulations for groundwater monitoring will fulfill the substantive requirements for groundwater monitoring in the UMTRCA regulations.

- DOE M 435.1-1 Environmental Monitoring, which requires low-level radioactive waste disposal facilities to perform environmental monitoring for all media, including groundwater. Compliance with RCRA/Ohio Hazardous Waste and Ohio Solid Waste regulations for groundwater monitoring will fulfill the requirement for groundwater monitoring in this Order, along with incorporating pertinent radiological parameters.

The following drivers were determined to necessitate an overall leak detection strategy:

- Ohio Municipal Solid Waste Rules, OAC 3745-27-06(C)(9a) and OAC 3745-27-10, which require that facilities prepare a groundwater monitoring plan that incorporates leachate monitoring and management to ensure compliance with OAC 3745-27-19(M)(4) and OAC 745-27-19(M)(5)

- Ohio Municipal Solid Waste Rules — Operational Criteria for a Sanitary Landfill Facility, OAC 745-27-19(M)(4) and (5), which require submittal of an annual operational report including:

  - A summary of the quantity of leachate collected for treatment and disposal on a monthly basis during the year, location of leachate treatment and/or disposal, and verification that the leachate management system is operating in accordance with the rule, and;

  - Results of analytical testing of an annual grab sample of leachate from the leachate management system.

3.2 OSDF MONITORING REGULATORY COMPLIANCE STRATEGY

Of the ARARs presented above, the Ohio Solid Waste and the Ohio Hazardous Waste regulations are the most prescriptive, and therefore warrant further discussion on how compliance with these two regulatory requirements will be met. The leak detection monitoring requirements of these two sets of regulations are similar, and dictate the development of detection monitoring plans capable of determining the facility's impact on the quality of water in the uppermost aquifer and any significant zones of saturation above the uppermost aquifer underlying the landfill.

Typically a detection monitoring program consists of the installation of upgradient and downgradient monitoring wells, routine sampling of the wells and analysis for a prescribed list of parameters, followed by a comparison of water quality upgradient of the landfill to water quality downgradient of the landfill. The detection of a statistically significant difference in downgradient water quality suggests that a release from the landfill may have occurred.

As discussed in Section 2.0, low permeability in the glacial till and pre-existing contamination within the glacial till and the Great Miami Aquifer, add complexity to the development of a groundwater detection monitoring program consistent with the standard approach of the Solid and Hazardous Waste regulations. Both sets of regulations accommodate such complexities by allowing alternate monitoring programs, which provide flexibility with respect to well placement, statistical evaluation of water quality, facility-specific analyte lists, and sampling frequency. The OSDF groundwater/leak detection monitoring program has required the use of an alternate monitoring program, in accordance with the criteria in the Ohio Solid and Hazardous Waste regulations. Compliance with the criteria is discussed below in Section 3.2.1.

The regulatory requirements for the leachate monitoring program are provided by the Ohio Solid Waste regulations. The compliance strategy for the leachate monitoring program is discussed below in Section 3.2.2.

3.2.1 Leak Detection Monitoring Compliance Strategy

The groundwater/leak detection monitoring program for the OSDF includes routine sampling and analysis of water drawn from four zones within and beneath the disposal facility including the LCS, the LDS, perched water within the glacial till, and the Great Miami Aquifer. This four-layered "holistic" approach allows for the earliest leak detection from the OSDF given the unique hydrogeologic and pre-existing contaminant situation at the site. However, this tailored approach differs from a typical leak detection monitoring program in several ways, and requires a compliance strategy to ensure that the program meets or exceeds the substantive requirements within the Ohio Solid and Hazardous Waste regulations. Below is a detailed discussion of compliance with several elements of the program, including alternate well placement, statistical analysis, monitoring frequency, and parameter selection. The implementation of the OSDF groundwater/leak detection program is presented in Section 4.0.

Note: Additional refinements to the monitoring/reporting process will be addressed and approved through various technical memoranda, annual site environmental reports, and/or weekly conference calls with the EPA/OEPA. After approval, the OSDF Project-Specific Plan (refer to Appendix B) will be revised and/or variances will be written to address updates as necessary.

3.2.1.1 Alternate Well Placement

The Ohio Solid Waste regulations require that a groundwater monitoring system consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from both the uppermost aquifer and any overlying significant zones of saturation (OAC 3745-27-10(B)(1)). Groundwater samples will be obtained through wells installed in the glacial till as well as the Great Miami Aquifer. The regulations also state that the wells must represent the quality of groundwater passing directly downgradient of the limits of solid waste placement (OAC 374-27-10(B)(1)(b)). In lieu of installing vertical glacial till monitoring wells along the perimeter of the OSDF, horizontal wells will be installed beneath the OSDF and screened beneath the liner penetration box of the LDS for each disposal cell where the greatest potential for leakage exists. Horizontal wells are preferred to vertical wells due to restrictions on well installation within 200 feet of waste placement so as to avoid interference with the disposal facility cap, and the absence of significant lateral flow within the overburden. The time required for contaminants to migrate laterally in the till toward wells located 200 feet from the limits of waste placement greatly exceeds the vertical travel time through the glacial till; therefore, the aquifer would be impacted by contaminants long before OSDF horizontal till wells could detect the release. Although the existence of the OSDF may result in dewatering of the glacial till such that samples cannot be regularly obtained, horizontal wells installed beneath the liner of the OSDF represent the highest potential for detecting releases to the till. Such an alternate placement for the till wells is allowed in the

Ohio Solid Waste regulations. The performance criteria in OAC 3745-27-10(B)(4) requires that the number, spacing, and depth of the wells must be based on site-specific hydrogeologic information and must be capable of detecting a release from the facility to the groundwater at the closest practicable location to the limits of solid waste placement. The placement of till wells beneath the facility, as opposed to along its perimeter, meets or exceeds the requirement to be located adjacent to waste placement.

3.2.1.2 Alternate Statistical Analysis

A statistical analysis is required in both the Ohio Solid and Hazardous Waste regulations (OAC 3745-27-10(C)(6) and OAC 3745-54-97(H)). The statistical analysis methods listed in the regulations are: parametric analysis of variance, an analysis of variance based on ranks, a tolerance or prediction interval procedure, a control chart approach, or another statistical test method. To date, the control chart approach (combined Shewart-CUSUM control charts) has been used as it has been determined the most viable approach. The preferred method of evaluation for the OSDF groundwater/leak detection monitoring data is an intra-well trend analysis following the establishment of baseline conditions in the perched water and Great Miami Aquifer beneath the OSDF. Although vertical monitoring wells are installed in the Great Miami Aquifer upgradient and downgradient of the OSDF, an intra-well comparison is more appropriate than an up- versus downgradient comparison until aquifer restoration is complete. Transient flow conditions within the aquifer, as well as the existence and anticipated fluctuation of contaminant concentrations at levels below the final remediation levels, discourage the use of a statistical comparison of upgradient and downgradient water quality as a reliable indicator of a release from the OSDF.

3.2.1.3 Alternate Parameter Lists

The process used to select the indicator parameter list, described in detail in Section 4.5, used the extensive RI database, and fate and transport modeling to evaluate potential indicator parameters. RIs have been completed for all Fernald site source terms and contaminated environmental media. The RIs included extensive sampling and analysis to characterize wastes and quantify environmental contamination so that health protective remedies, such as the construction of the OSDF, could be selected. Extensive databases were also used to develop WACs that consist of concentration- and mass-based limitations on the waste entering the OSDF. The WAC for the OSDF were developed with consideration of the types, quantities, and concentration of wastes that would be placed into the OSDF; the leachability, mobility, persistence, and stability of the waste constituents in the environment; and the toxicity of the waste constituents. Of 93 constituents that were evaluated for waste acceptance, 18 were identified as having a relatively higher potential to impact the aquifer within the 1000-year, specified performance period. Maximum allowable concentration limits were established for wastes containing these constituents.

The factors used to establish WAC are similar to the consideration criteria for development of an alternate parameter list specified in the Ohio Solid and Hazardous Waste regulations (OAC 3745-27-10(D)(2) and (3); OAC 3745-54-93(B); OAC 3745-54-98(A)) and OEPA policy and guidance (Solid Waste Policy DDAGW-04-03-221, Interim Solid Waste Guidance GD0403.222 and GD0403.205). The methodology for developing an OSDF-specific leak detection monitoring parameter list used the WAC methodology and the Ohio Solid and Hazardous Waste regulatory criteria to identify waste constituents that are expected to be derived from wastes placed in the OSDF, and will be reliable indicators of a release from the OSDF.

3.2.1.4 Alternate Sampling Frequency

The Ohio Solid Waste regulations require that, for detection monitoring, at least four independent samples from each well will be taken to determine the baseline water quality during the first 180 days after implementation of the groundwater detection monitoring program (OAC 3745-27-10(D)(5)(a)(ii)(a)). Note that baseline monitoring continues after initiation of waste placement and during active cell operations in order to collect sufficient data to perform the required statistical analyses.

The Ohio Hazardous Waste regulations do not specify a frequency for determining a baseline dataset. A typical statistical test for a hazardous waste disposal facility requires an up- versus downgradient comparison of background water quality to downgradient water quality. The Ohio Hazardous Waste regulations do require a performance standard for establishing background; OAC 3745-54-97(G) states that the number and kinds of samples taken to establish background be appropriate for the statistical test employed. Experience/technical knowledge gained from monitoring Cells 1 through 3 have indicated that it is necessary to collect baseline samples either monthly, bimonthly, or quarterly in order to have enough data (i.e., 12 samples) to perform statistics on a standardized frequency dataset. The baseline frequency is selected to develop an appropriate statistical procedure, to address OSDF construction schedules, and to compensate for the varying temporal conditions in the groundwater flow direction and chemistry due to the remedial action and seasonal fluctuations.

The Ohio Solid Waste regulations require a semiannual sampling frequency for detection monitoring but also allow for the proposal of an alternate sampling program (OAC 3745-27-10(D)(5)(a)(ii)(b) and (b)(ii)(b), and 3745-27-10(D)(6)). During active cell operations (more specifically, post-baseline monitoring prior to cell capping), the sampling frequency for the OSDF groundwater/leak detection monitoring program will be quarterly for the indicator parameters, which exceeds the semiannual frequency requirement. After each cell is capped, it is planned that monitoring for each of the four components (i.e., the LCS, LDS, horizontal till well, and Great Miami Aquifer wells) for the site-specific leak detection indicator parameters will be done on a semiannual basis to continue to meet regulatory requirements.

3.2.2 Leachate Monitoring Compliance Strategy

The Solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate on an annual basis for Appendix I and polychlorinated biphenyls (PCBs) parameters listed in OAC 3745-27-10. Leachate samples in the LCS will be collected and analyzed for site-specific leak detection indicator parameters to support leachate treatment and discharge, as well as the annual analysis for Appendix I parameters and PCBs. The annual grab sample analysis for Appendix I parameters and PCBs will ensure the accuracy of assumptions regarding the nature of wastes within the OSDF that were used to develop the groundwater/leak detection parameter list.

Although constituents that are not part of the limited indicator parameter list for leak detection may be detected in the annual grab, it is not anticipated that the concentrations will be high enough to warrant revision of the leak detection parameter list. However, a review of the data will be conducted (and reported through the annual site environmental reports) to determine if any new indicator constituents should be added to the site-specific leak detection indicator parameter list. A constituent will be added if: (1) concentrations observed in the annual sample are much higher than the perched water concentrations at the Fernald site; and (2) routine analysis of the constituent can significantly enhance early detection capability. The leak detection leachate analysis will ensure that the character of the leachate will not adversely impact the treatment facility or the treatment facility effluent receiving stream (the Great Miami River).

Although not specified in the Operable Unit Records of Decision as an ARAR, the federal RCRA (Hazardous Waste) regulations include specific requirements in 40 CFR 264.303 for monitoring the volume of liquid collected from a disposal facility's leak detection system. Regulation 40 CFR 264.302 includes provisions for determining an "action leakage rate" that, if exceeded, would prompt specific response and notification actions. It is anticipated that this "action leakage rate" will be established via trend analysis on closed cells prior to closure of the last cell of the OSDF (discussed in Section 4.0). The response and notification process for an exceedance of the "action leakage rate" (40 CFR 264.304) is provided in Section 6.0.

The leachate monitoring strategy, as part of the groundwater monitoring plan and required by OAC 3745-27-06(C)(7), must include provisions for obtaining the monthly volume of leachate collected for subsequent treatment, provide the method of leachate treatment and/or disposal, and include verification that the leachate management system is operating properly (OAC 3745-27-19(M)(4)). Monitoring to verify that the leachate management system is operating properly is provided within the OSDF Systems Plan.

The monthly volume of leachate collected for treatment and subsequent disposal will be obtained based on the program in 40 CFR 264.303(c) to determine the flow rates of leachate collected in the LCS and water in the LDS. Monitoring the flow rates will provide data for determining the volume of leachate collected and will also provide data pertinent to the leak detection monitoring program. The flow rates are part of the leak detection monitoring program and are discussed further in Section 4.0. A separate leachate management monitoring strategy is provided as Section 5.0 to provide information on the method of leachate treatment and/or disposal, including analysis of parameters useful for leachate treatment. Section 5.0 also includes a discussion on obtaining an annual grab sample to be analyzed for Appendix I parameters and PCBs, in order to comply with the requirement in OAC 3745-27-19(M)(5).

4.0 LEAK DETECTION MONITORING PROGRAM

This section presents the technical approach for leak detection monitoring at the OSDF, in light of the regulatory requirements for leak detection monitoring summarized previously in Section 3.0. The section includes a summary of the objectives of the program; a description of the major program elements; the selection process for analytical parameters (i.e., site-specific leak detection indicator parameters); the monitoring to be employed to establish baseline during active cell operations and after cells have been capped; and the strategy for evaluating the data to determine whether a leak has occurred. The subsections are as follows:

- Section 4.1: Introduction
- Section 4.2: Monitoring Objectives
- Section 4.3: Leak Detection Monitoring Program Elements
- Section 4.4: Selection Process for Site-Specific Leak Detection Indicator Parameters
- Section 4.5: Leak Detection Sample Collection
- Section 4.6: Leak Detection Data Evaluation Process

Additionally, Appendices B and C provide the Project-Specific Plan and Data Quality Objectives for the OSDF Monitoring Program for each cell, with details on specific monitoring lists and frequencies. Section 5.0 describes the overall leak detection strategy including the collection and analysis of an annual leachate grab sample for Appendix I and PCB parameters per OAC 3745-27-10 and 19 to confirm the adequacy and appropriateness of the selected site-specific leak detection indicator parameters. A summary of the notifications and potential follow-up response actions that accompany the monitoring program is provided in Section 6.0.

4.1 INTRODUCTION

As discussed in Section 1.0, the OSDF leak detection monitoring program constitutes the first tier of a three-tiered detection, assessment, and corrective action monitoring strategy that is required for engineered disposal facilities. Consistent with this three-tiered approach, if it is determined from this detection monitoring program that a leachate leak from the OSDF has occurred, follow-up assessment and corrective action monitoring plans will be developed and implemented as necessary. Conversely, if the detection monitoring successfully demonstrates that leachate leaks have not occurred, then the monitoring program will remain in the first-tier "detection mode" indefinitely. The follow-up assessment and/or corrective action monitoring plans, if found to be necessary, would be prepared as new, independent plans that would supersede this first-tier detection program.

The leak detection monitoring program employs a multi-component, holistic approach for leak detection, relying on the collective responses obtained from four components: an LCS inside the OSDF; an LDS inside the OSDF and below the LCS; a perched groundwater monitoring component, which is located beneath the compacted clay liner immediately below the LDS and LCS liner penetration boxes (see Figure 4-1); and a Great Miami Aquifer monitoring component, found at depths ranging from 40 to 90 feet beneath the OSDF. The data collected from the four components will be evaluated comparatively over time, so that short-term and long-term response relationships between the components can be effectively delineated.

Clearly, the Great Miami Aquifer is the prime resource of concern that could potentially be affected by the OSDF, in the unlikely event that a leachate leak occurred. It therefore makes sense to monitor the aquifer at the immediate boundary of the OSDF to ensure the absence of impact. However, as discussed in Section 2.0, contaminant travel times to the aquifer through the glacial till beneath the OSDF are of such length that reliance on Great Miami Aquifer monitoring alone would be insufficient to provide effective early warning of a leak from the facility. The overriding intention of the holistic approach, therefore, is to ensure that there is no reliance on any one element alone to determine whether leakage has occurred. As is demonstrated in this section, the groundwater/leak detection monitoring program includes the establishment of baseline conditions in the native environment underlying the OSDF (i.e., perched and Great Miami Aquifer groundwater) to be used as a point of comparison during the system-wide evaluation of trends. Following the establishment of baseline conditions, the follow-up sampling being conducted at each monitoring interval provides a "vertical slice/snapshot in time" view of conditions that are present in each of the four components, which can be compared to past results to determine the collective significance of trends or intermittent fluctuations in the data.

4.2 MONITORING OBJECTIVES

The fundamental objective of the leak detection monitoring program is to provide early detection of a leak from the facility, should one occur. Recognition of this fundamental objective allows the Fernald site to move confidently into the next regulatory-based tiers of the program—assessment and corrective action monitoring—should they be necessary based on detection monitoring trends. This fundamental objective is the primary driver for all of the key site-specific elements (i.e., monitoring locations, frequencies, analytical parameters, and follow-up response actions) of the program.

In addition to this fundamental objective, there are several other objectives that have been considered in the site-specific design of the leak detection program:

- The program must have the ability to distinguish an OSDF leak from the above-background pre-existing levels of contamination that are found in the subsurface;
- All monitoring wells must be installed at locations and with construction methods that do not interfere with or compromise the integrity of the cap and liner system of the OSDF;
- The program needs to be readily implementable and not overwhelming in terms of reporting, data management, and the ability to identify trends; and
- The program needs to satisfy the site-specific regulatory requirements for leak detection monitoring summarized in Section 3.0.

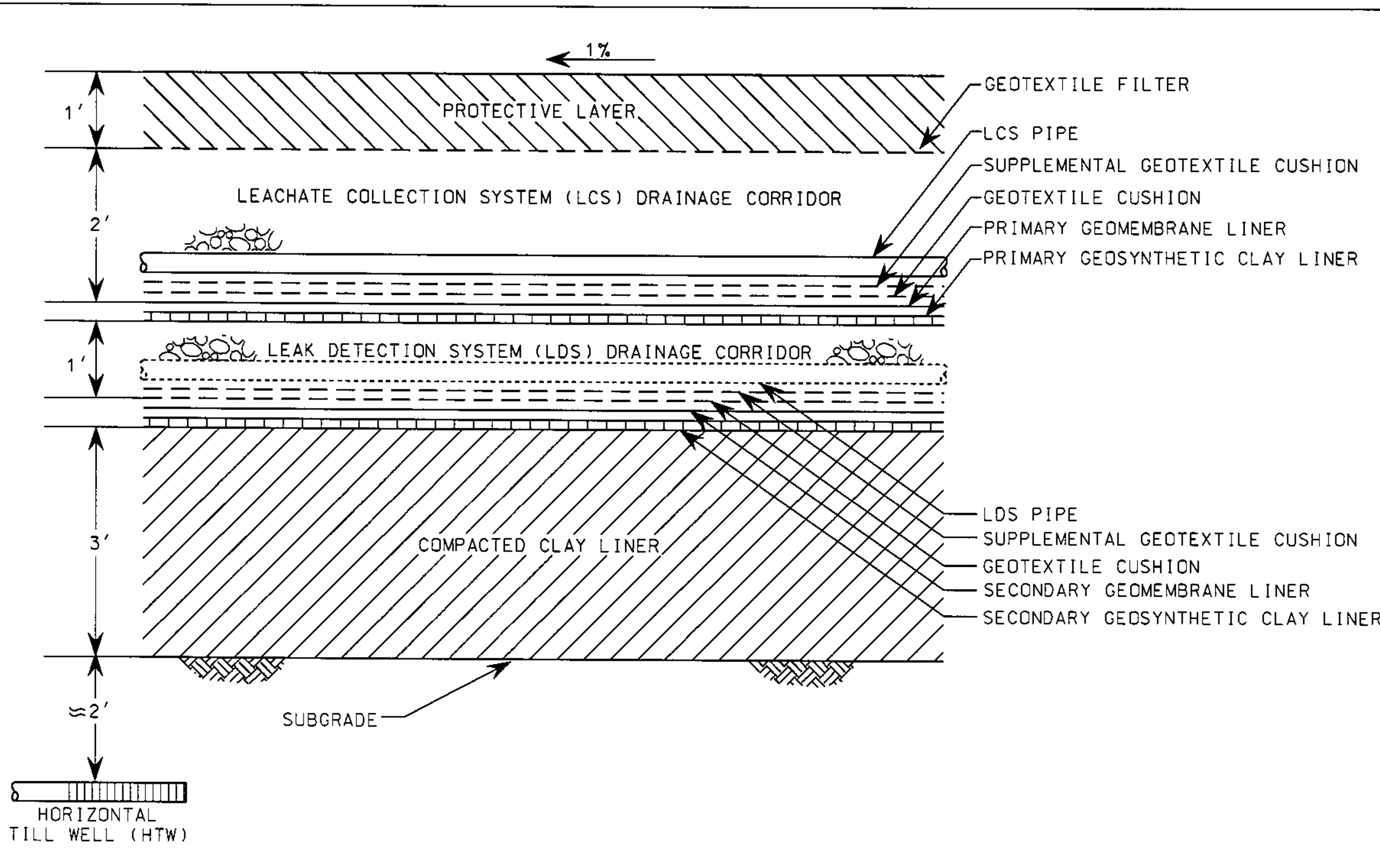
The four-component leak detection monitoring approach described below meets the intent of providing early detection of a release from the OSDF within the complex hydrogeologic regime at the Fernald site, and is tailored to accommodate the additional program design objectives summarized above.

4.3 LEAK DETECTION MONITORING PROGRAM ELEMENTS

4.3.1 Overview

The success of the leak detection monitoring strategy for the OSDF is dependent upon how well the strategy integrates with facility integrity concerns (cap and liner system performance) and how well the groundwater component of the strategy addresses hydrogeologic conditions in the till and aquifer. The trends revealed by groundwater monitoring data need to be effectively integrated with leachate production information within the OSDF in order to provide a comprehensive evaluation of the OSDF performance and integrity.

The approved design for the OSDF is presented in detail in the initial OSDF Design Package and subsequent approved follow-up design and construction drawing packages. The OSDF consists of eight individual cells (plus a ninth contingency cell) to be constructed in phases. As shown in Figure 4-1, the liner for each cell is a composite liner system, assembled from the following layers (top to bottom): a soil cushion layer; geotextile fabric; LCS drainage layer; primary composite liner; high-density polyethylene (HDPE) (geotextile fabric, HDPE geomembrane, and geosynthetic clay liner); LDS drainage layer; and the underlying secondary composite liner (HDPE geomembrane, geosynthetic clay liner, and compacted clay). Both the LCS and LDS layers each drain to the west within each cell. At the western edge of each cell liner, any liquid within the LCS and LDS passes through the liner penetration box and



DRAFT

V:/5FGP1/DGN/OSDF-GWLMP/OSDFGWLMP02.DGN
08-JUN-2004

FIGURE 4-1. ON-SITE DISPOSAL FACILITY LINER SYSTEM WITH HTW AT THE DRAINAGE CORRIDOR flows to the respective cell's valve house. As identified previously, the liner penetration box represents the area with the greatest leak potential for each cell and is considered the primary location where a leak would first enter the environment if a leak were to occur.

Each cell is also furnished with an engineered composite cover system following the completion of waste placement. The cover system consists of the following layers (top to bottom): a vegetative cover layer; a topsoil layer; a granular filter layer; a bio-intrusion barrier; a geotextile filter; a cover drainage layer; the primary composite cap (geotextile cushion, HDPE geomembrane, geosynthetic clay liner, and compacted clay); and an underlying contouring layer. Once the cover system is in place and the cell contents have reached equilibrium, leachate production is expected to diminish as a result of the moisture infiltration barrier properties of the cover system. During the time that the cell contents move towards equilibrium, leachate accumulation in the LCS drainage layer is expected to diminish over time.

During active cell operations and following OSDF closure, the leak detection monitoring program involves: (1) tracking the quantity of liquid produced within the LCS and LDS over time; and (2) the periodic water quality monitoring of the leachate, the perched groundwater, and the Great Miami Aquifer groundwater. Monitoring activities during active cell operations and post-closure operations consist of baseline monitoring and post-baseline monitoring (during active cell operations and after cells are capped) which use components of site-specific analytical parameters to effectively implement a holistic comparative approach. The performance of each cell is monitored individually, on its own merit; each cell has its own engineered LCS and LDS drainage layers, perched groundwater monitoring component, and upgradient and downgradient Great Miami Aquifer monitoring wells.

4.3.2 Monitoring the Engineered Layers within the OSDF

Water quality samples are collected from individual LCS and LDS drainage layers within each cell during waste placement and after cell closure as described below and per Section 5.0 (i.e., annual leachate grab samples are collected and analyzed to confirm the adequacy and appropriateness of the selected site-specific leak detection indicator parameters). In addition to water quality monitoring, the quantity of liquid within the LCS and LDS layers is recorded and reported. This information is used to support a collective qualitative trend analysis for each cell of the OSDF as discussed later in this plan.

4.3.2.1 Leachate Collection System (LCS)

The LCS drainage layer functions primarily to collect infiltrating water (expected to be greatest during construction of the cell) and to keep it from entering the environment. It is expected that infiltrating water will be greatly reduced after each cell is capped, which may subsequently limit the available sample volume and possibly affect the number of parameters that can be analyzed. The LCS drains to the west through an exit point in the liner to leachate transmission system located on the west side of the OSDF. From there, the leachate flows by gravity to a lift station and is currently pumped to the Fernald site's Bio-Surge Lagoon for subsequent treatment at the Advanced Wastewater Treatment (AWWT) facility.

Current site plans are for AWWT to be reduced in both size and capacity, referred to as the converted AWWT (CAWWT). With the scheduled permanent shut-down of the Bio-Surge Lagoon in November 2004, leachate will be redirected to the storm water retention basin (SWRB). During the conversion process of the AWWT facility, leachate collected in the SWRB will be routed for treatment in the AWWT. When the CAWWT is operational in February 2005, the leachate collected in the SWRB will be routed to the new CAWWT facility. Leachate will be managed in this manner until October 2005 when the SWRB is removed from service to support soil remediation in the SWRB footprint. At that time, leachate will be routed directly to the CAWWT facility for treatment.

Both flow (quantity/volume) and water quality information are collected from the LCS drainage layer according to Section 4.4, Section 4.5, and Appendix B (the OSDF Project-Specific Plan).

4.3.2.2 Leak Detection System (LDS)

By design, the primary composite liner located underneath the LCS drainage layer should not leak. Fluids that accumulate from time to time in the LCS drainage layer above the primary liner are removed to further reduce the potential for leakage by minimizing the level of fluid head build up on the primary liner. Notwithstanding this design, a second fluid collection layer, the LDS drainage layer, is positioned beneath the primary composite liner to provide a means to track the integrity and performance of the primary liner. In the event that fluids collect within the LDS layer, the fluids drain to the west where they are removed and routed for treatment as in the LCS.

Similar to the LCS, a greater volume of fluids may initially collect in the LDS as the moisture content of the materials comprising the liner move toward long-term equilibrium levels. This fluid volume is expected to gradually decrease over the long term. Below the LDS drainage layer is a secondary composite liner comprised of an HDPE geomembrane, geosynthetic clay liner, and compacted clay. This secondary liner serves as the lowermost hydraulic barrier in the liner system and inhibits fluids from entering the environment before they are collected and removed through the LDS drainage layer.

Like the LCS drainage layer, both flow (quantity/volume) and water quality information are collected from the LDS drainage layer according to Section 4.4, Section 4.5, and Appendix B (the OSDF Project-Specific Plan).

4.3.3 Monitoring the Perched Groundwater

The perched groundwater monitoring component of the program is designed to monitor for the presence of leachate leakage from the OSDF at its first point of entry into the Fernald site's natural hydrogeologic environment. As discussed in Section 1.0, EPA, OEPA, and DOE concur that a horizontally oriented glacial till monitoring well (i.e., a horizontal till well), positioned directly beneath the location of the LCS and LDS liner penetration box in each cell, represents the most feasible site-specific approach to monitor for first-entry leakage from the OSDF into the Fernald site's environment.

The horizontal till wells have been installed as part of the sub-grade construction activities for each of the cells comprising the OSDF. The individual wells were installed prior to waste placement, therefore eliminating final positioning uncertainties that would be associated with post-construction horizontal drilling techniques. The vertical portion of each of the monitoring wells is located along the western side of the OSDF (see Figure 4-2), while the sample collection interval is positioned beneath the bottom of the secondary composite liner in alignment with the location of the LCS and LDS liner penetration box.

Lithologic and hydraulic characterization of the till in the vicinity of the OSDF indicates that the clay-rich deposits may not readily yield fluid to a well. The amount of saturation in the till is likely to be further reduced in the future by the barrier properties of the composite cover and liner system of the OSDF, which will operate to significantly reduce local infiltration beneath the facility. These conditions may make it impossible to obtain sufficient sample volume from the till wells to perform detailed water quality analyses. In the event sufficient sample volume cannot be obtained to perform the full list of required analyses, a priority list will be implemented as necessary as identified in Appendix B.

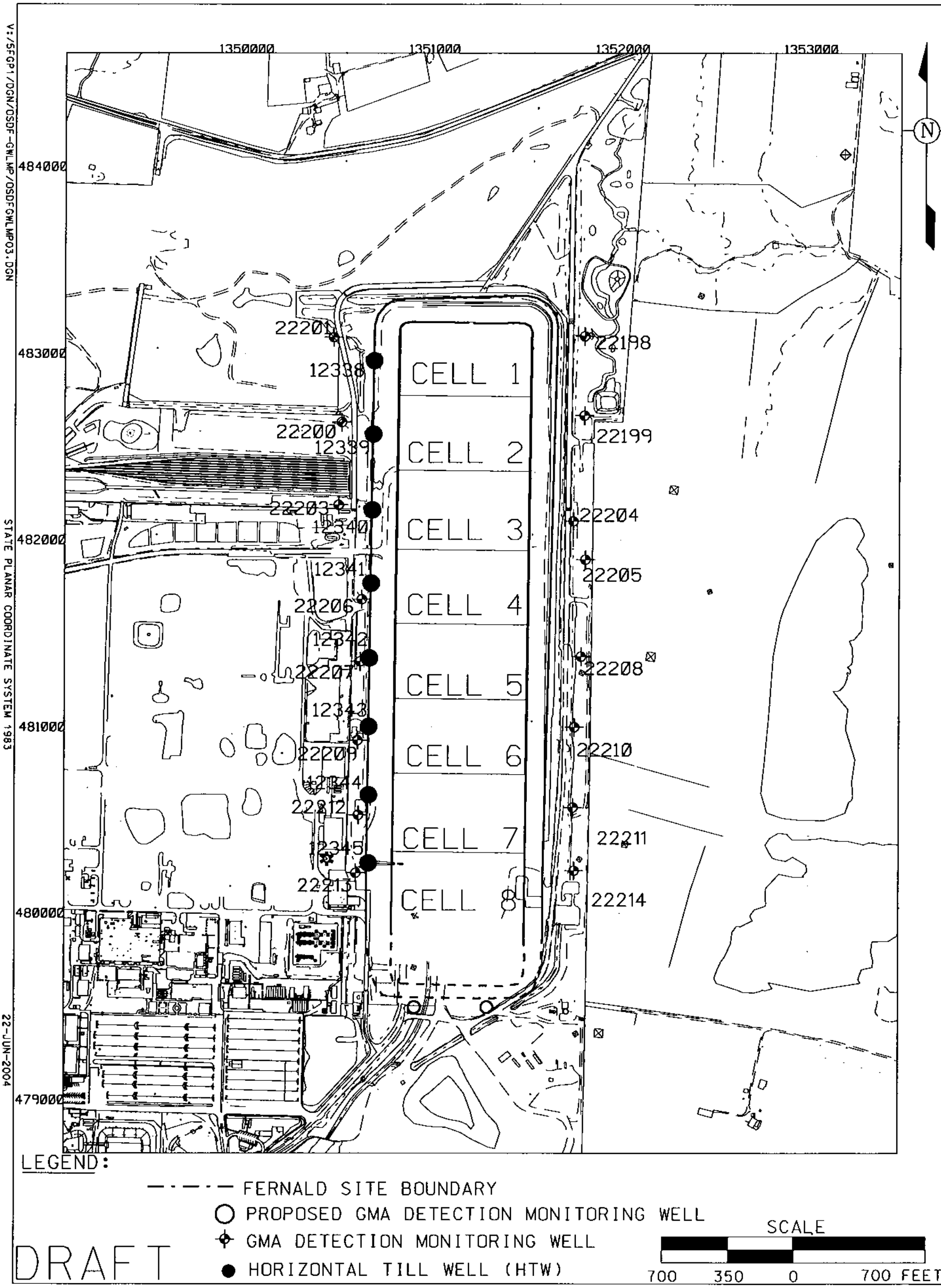


FIGURE 4-2. OSDF WELL LOCATIONS

Water quality information is collected from the horizontal till wells according to Section 4.4, Section 4.5, and Appendix B (the OSDF Project-Specific Plan). Based on experience and technical knowledge gained, purging prior to sampling the horizontal till wells was implemented to ensure sample independence.

4.3.4 Monitoring the Great Miami Aquifer

The subsections below describe the Great Miami Aquifer component of the program, including a discussion of the influence of planned aquifer restoration activities on the program, the siting of the monitoring wells, and use of the groundwater models (i.e., Variably Saturated Analysis Model in 3 Dimensions [VAM3D] and Sandia Waste Isolation Flow and Transport [SWIFT]) to evaluate the adequacy of the planned well locations.

4.3.4.1 Siting of the Great Miami Aquifer Monitoring Wells

The Great Miami Aquifer monitoring wells have been installed immediately adjacent to the OSDF, just outside the footprint of the final composite cap configuration, so as not to interfere with the integrity of the facility. Each cell has its own set of monitoring wells to assist with the evaluation of conditions associated with that cell. As each new cell has been brought online, its associated monitoring wells have been installed before (or concurrently with) the construction of the cell liners so that the wells have been available for the initiation of baseline sampling prior to waste placement. Thus the well installations have followed the north-to-south progression of OSDF cell construction. The OSDF is bordered by a network of 18 Great Miami Aquifer monitoring wells, which provide upgradient and downgradient monitoring points for each cell (see Figure 4-2). All monitoring wells were constructed in accordance with the Sitewide CERCLA Quality (SCQ) Assurance Project Plan (DOE 2003b) for Type 2 Great Miami Aquifer wells.

The overall objective of the Great Miami Aquifer component of the leak detection monitoring program is to provide long-term surveillance. The current and future (post-remediation) aquifer flow conditions were therefore used to select the 18 monitoring locations. As discussed in the next subsection, groundwater flow and particle tracking using both the VAM3D and the SWIFT aquifer simulation models were used to help select the final monitoring locations identified in this plan.

4.3.4.2 VAM3D Flow Model and SWIFT Transport Model Evaluation of Well Locations

The VAM3D and SWIFT groundwater modeling codes were used to evaluate the adequacy of the density and locations of the monitoring wells planned for the Great Miami Aquifer. The modeling effort examined the fate of a hypothetical release from each cell to the aquifer at a point directly beneath the liner penetration box of the LCS and LDS. The groundwater model runs predicted the most likely flow path and plume configuration for particles released from the liner penetration box area over time. The modeling was conducted for post-aquifer remediation conditions (when groundwater flow directions would be from west to east). The original modeling was performed using the SWIFT groundwater model as part of the IEMP, Revision 0, and has been updated subsequently using the VAM3D groundwater model.

Particle flow path modeling was conducted using the VAM3D flow model output from two model runs representing seasonal wet and dry conditions within the aquifer. Fifteen particles were seeded in a 125-foot radius around each of nine model nodes located nearest the nine cell liner penetration box locations. These particles were tracked for a 20-year period with no retardation. The velocity flow field data from the post-aquifer remediation scenario shows the advective particle path results (Figure 4-3). The particle tracks are generally from west to east beneath the OSDF. As indicated in the figure, the tracks deviate slightly in the north-south direction with seasonal water level fluctuations in the aquifer. Downgradient monitoring wells were located in the area traced out by the modeled flowpaths for each OSDF cell in order to be in the most likely position to detect a leak based on anticipated groundwater flow. These flow model results are similar to the flow modeling results previously obtained with the SWIFT groundwater model, which was used prior to converting to the VAM3D modeling code. Monitoring wells for Cells 1 through 3 were placed based on the results from the SWIFT groundwater flow model (provided in Revision 0 of this plan) and monitoring wells from Cells 4 through 8 were placed based on the results from the VAM3D flow model (DOE 2000).

An earlier SWIFT model transport simulation was performed for Revision 0 of this plan to determine if the density of the downgradient Great Miami Aquifer monitoring well network is adequate to detect the smallest contaminant plume resulting from a leak in the OSDF that would be of concern. Those SWIFT model results are included here for completeness. The SWIFT model was used to simulate a leak from the cell liner penetration box beneath Cell 3 under natural flow gradients with no on-site pumping. Model simulations for both uranium and technetium-99 were performed. Constant loading from the cell was simulated throughout the model run such that a plume of minimum areal extent (i.e., a plume with maximum concentration equal to the FRL) was maintained in the aquifer. Hypothetical plumes of 20 parts per billion and 94 picoCuries per liter (pCi/L) were maintained for uranium and technetium-99, respectively. The plumes were loaded from two hypothetical locations. One location was approximated to be beneath the cell liner penetration box at the western edge of Cell 3, in order to represent the most likely leakage point from the cell.

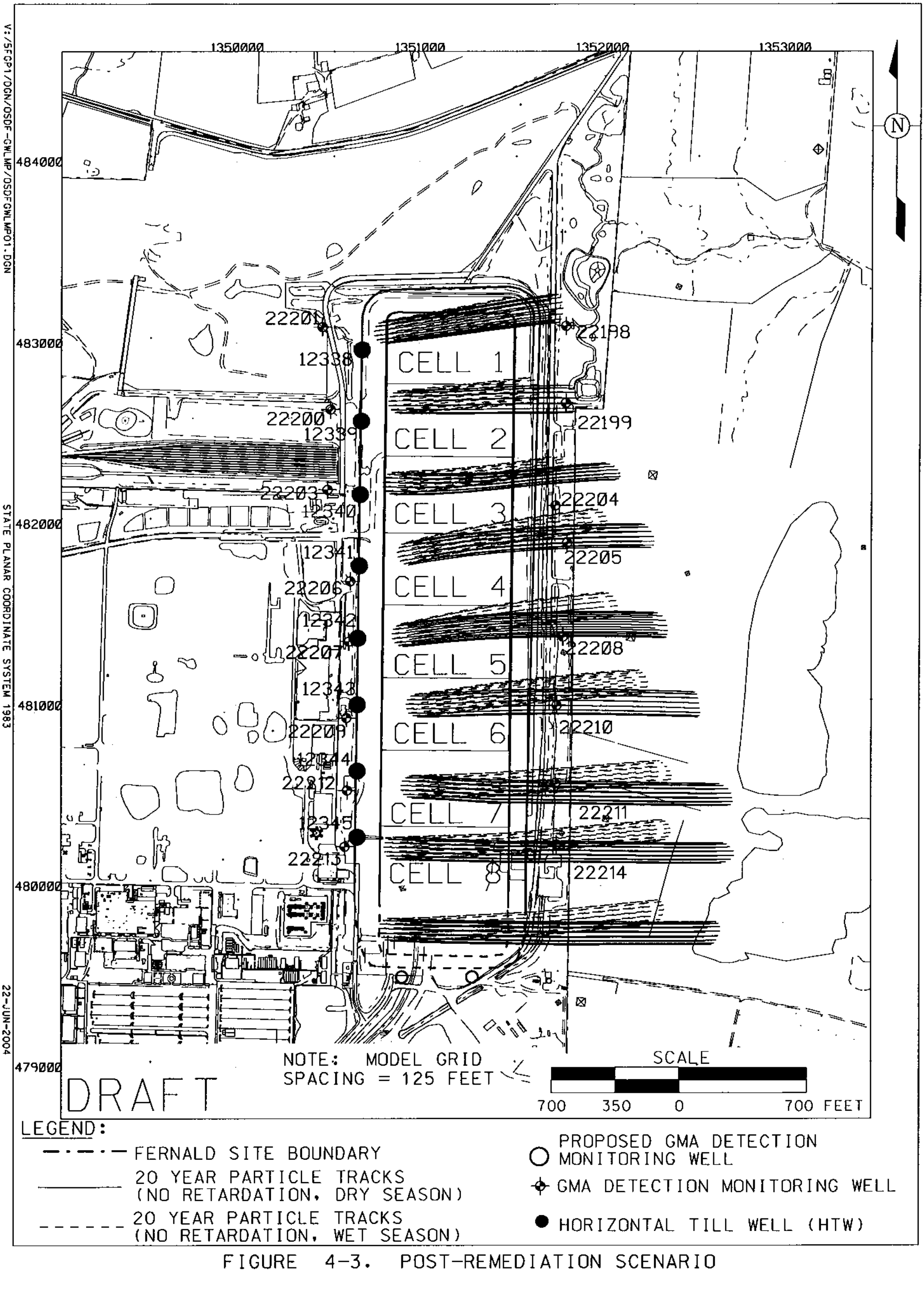


FIGURE 4-3. POST-REMEDIATION SCENARIO

The other location was further east, in order to provide a more conservative scenario where the plume would have less time to expand before the leading edge would reach the downgradient monitoring well network.

The modeling results for uranium at model year 55 (2051) and for technetium-99 at model year 30 (2026) are shown in Figures 4-4 and 4-5, respectively. The durations were determined from the modeling, and represent the period of time under constant loading for the respective plumes to disperse to the width of the spacing distance between monitoring wells (approximately equal to the OSDF cell width). Modeling results indicate that the density of downgradient Great Miami Aquifer monitoring wells is sufficient to detect this minimal plume given the lateral expansion and the plume width under this minimal constant loading.

The width of each plume from horizontal dispersion is approximately the width of an OSDF cell, indicating that one downgradient Great Miami Aquifer monitoring well per cell is sufficient to ensure that a Great Miami Aquifer contaminant plume would be detected. Therefore, the configuration of Great Miami Aquifer wells (shown in Figure 4-2) is sufficient both in terms of well density and location for the OSDF leak detection monitoring program.

4.4 SELECTION PROCESS FOR SITE-SPECIFIC LEAK DETECTION INDICATOR PARAMETERS

As discussed in the regulatory analysis provided in Section 3.0, a successful leak detection monitoring program must focus on the best indicators of potential releases, as opposed to analyzing for every possible constituent that may be present in a disposal facility (which would not be manageable and would add unnecessary complexity to the data analysis process). This section presents the criteria and process used to identify the site-specific indicator parameters for the OSDF groundwater leak detection monitoring program. The selected indicator parameters supplement the leachate flow monitoring conducted in the LCS and LDS layers (described in Section 4.5) to promote the early detection of potential leaks from the facility.

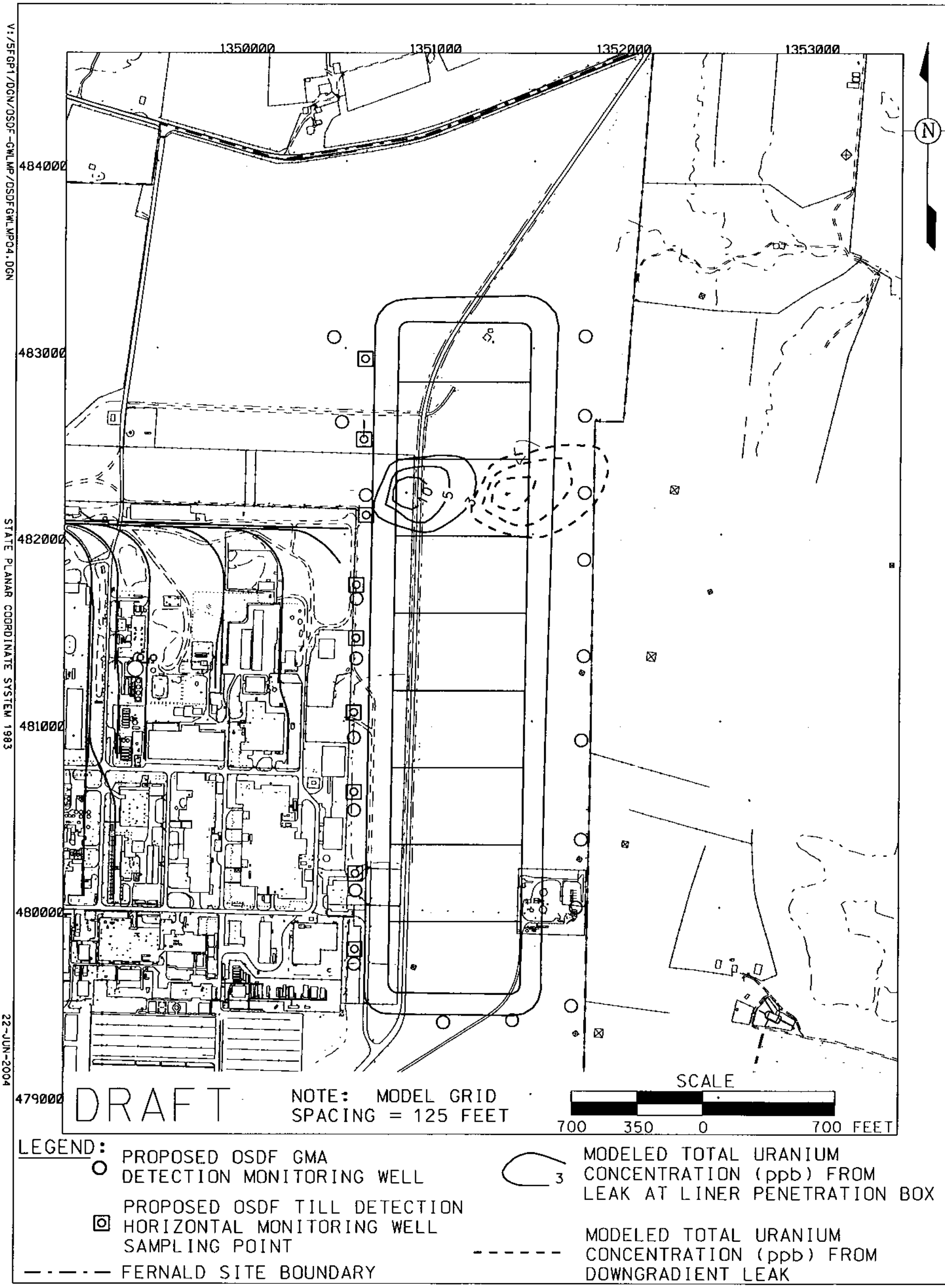


FIGURE 4-4. SWIFT MODELING WITH URANIUM LOADING - 55 YEARS

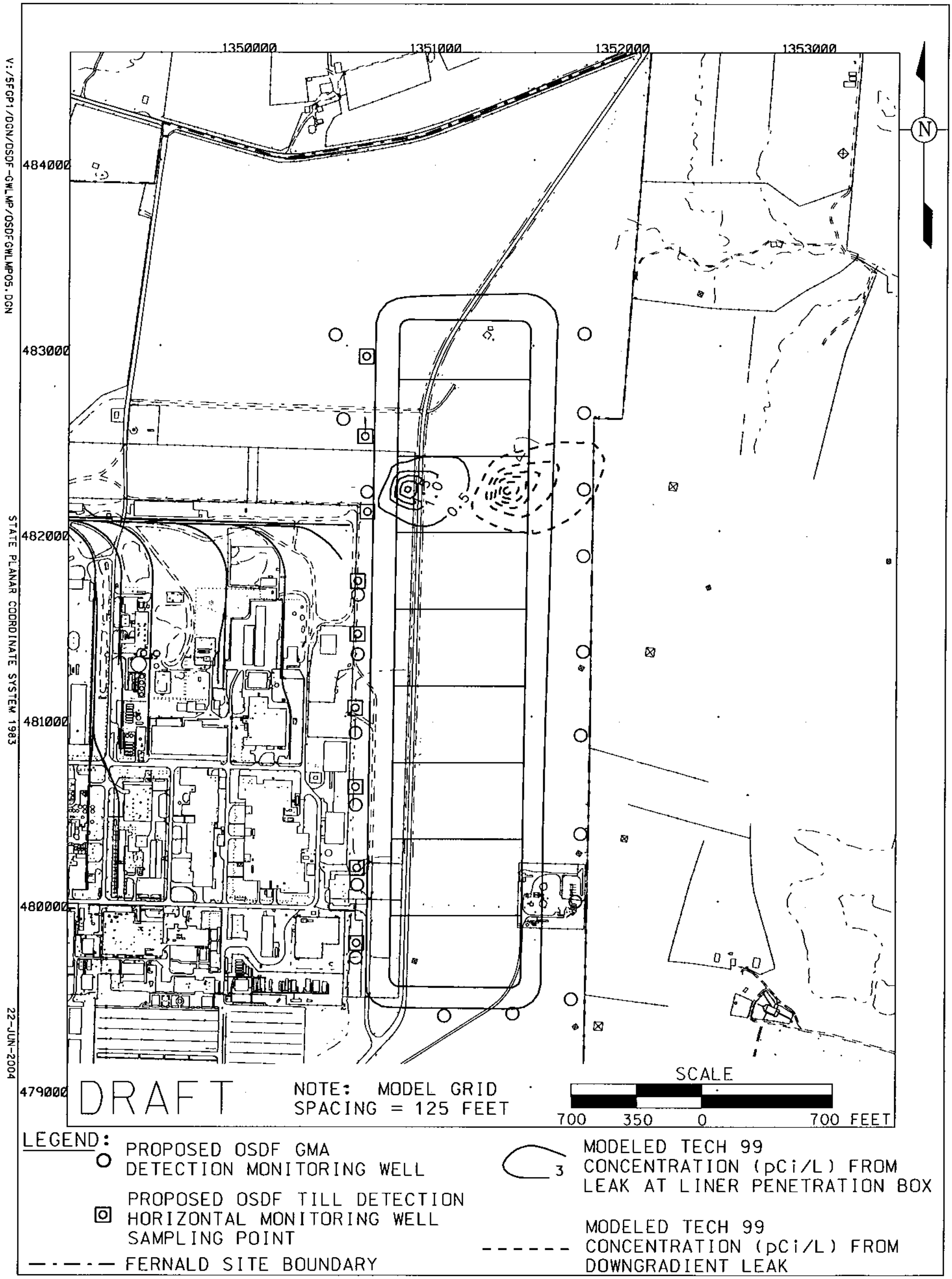


FIGURE 4-5. SWIFT MODELING WITH TECH 99 LOADING - 30 YEARS

4.4.1 Guidelines for Site-Specific Monitoring Parameter Selection

At the Fernald site, residual contamination in soil is expected to move through the glacial till and impact the aquifer at concentrations below the groundwater FRLs, but statistically elevated above current background conditions. It is important to recognize that all of the inorganic constituents and all but nine organic constituents included in the regulatory default monitoring parameters list (i.e., Appendix I of OAC 3745-27-10) have been detected in perched groundwater samples collected at various locations under the Fernald site. Such pre-existing contamination in the environment beneath the site along with aquifer remediation activities add complexity to the development of a successful leak detection parameter list capable of indicating the presence of a leak from the OSDF. Therefore a tailored leak detection parameter list has been developed that provides adequate leak detection and that is in compliance with the standard requirements of the Ohio Solid Waste Rules and the Ohio Hazardous Waste Rules. As discussed in Section 3.0, both sets of rules allow the use of an alternate monitoring parameter list based on site-specific conditions.

Ohio Solid Waste regulations OAC 3745-27-10(D)(2) and (3) allow six considerations in proposing an alternate monitoring parameter list in lieu of some or all of the parameters listed in Appendix I of OAC 3745-27-10. Also, the Ohio Hazardous Waste regulations for new facilities, OAC 3745-54-98(A), recognize four considerations in formulating the facility-specific monitoring parameter list. Table 4-1 summarizes the important considerations and approval criteria related to monitoring parameter selection under the Ohio Solid Waste and Ohio Hazardous Waste regulations.

It is important to point out that the chemical constituents listed in Appendix I of OAC 3745-27-10 are typical contaminants found in sanitary landfills. Appendix I does not include any radionuclides which are the primary contaminants of concern at the Fernald site. Therefore, any site-specific constituents not included in Appendix I of OAC 3745-27-10 but that are good indicators of potential leaks from the OSDF also need to be evaluated in the parameter selection process (refer to Section 5.0). However, the general considerations summarized in Table 4-1 can apply to any constituents when selecting the leak detection indicator parameters.

TABLE 4-1

REGULATORY CRITERIA FOR ALTERNATE PARAMETER LIST

Ohio Solid Waste Regulation	Ohio Hazardous Waste Regulation
REQUIREMENTS:	
• for all parameters, the removed parameters are not reasonably expected to be in or derived from the waste contained or deposited in the landfill facility; and [OAC 3745-27-10 (D)(2)]	-
• for inorganic parameters, the approved alternative monitoring parameter list will provide a reliable indication of inorganic releases from the landfill facility to the groundwater. [OAC 3745-27-10 (D)(3)]	indicator parameters (e.g., specific conductance, total organic carbon, or total organic halogen), waste constituents, or reaction products that provide a reliable indication of the presence of hazardous constituents in groundwater. [OAC 3745-54-98 (A)]
CONSIDERATIONS:	
• types, quantities, and concentrations of constituents to be managed at the facility; [OAC 3745-27-10 (D)(2)(b) and (D)(3)(a)]	types, quantities, and concentrations of constituents to be managed at the regulated unit; [OAC 3745-54-98 (A)(1)]
• mobility, stability, and persistence of the waste constituents or their reaction products in the unsaturated zone beneath the facility; [OAC 3745-27-10 (D)(3)(b)]	mobility, stability, and persistence of the waste constituents or their reaction products in the unsaturated zone beneath the waste management area; [OAC 3745-54-98 (A)(2)]
• concentrations in the leachate from the relevant unit(s) of the facility; [OAC 3745-27-10 (D)(2)(c)]	-
• detectability of the parameters, waste constituents, and their reaction products in the groundwater; [OAC 3745-27-10 (D)(3)(c)]	detectability of the indicator parameters, waste constituents, and their reaction products in the groundwater; and [OAC 3745-54-98 (A)(3)]
• concentrations or values and coefficients of variation of monitoring parameters or constituents in the background [baseline] groundwater quality; and [OAC 3745-27-10 (D)(3)(d)]	concentrations or values and coefficients of variation of monitoring parameters or constituents in the background [baseline] groundwater quality. [OAC 3745-54-98 (A)(4)]
• any other relevant information. [OAC 3745-27-10 (D)(2)(d)]	-

Parameter selection focuses on establishing baseline conditions for individual cells of the OSDF and provides the initial rationale for post-baseline monitoring and monitoring in capped cells. Parameters selected for the baseline sampling and analysis approach of the OSDF groundwater monitoring program were selected using site-specific contamination data generated during the previous RI/FS processes in accordance with the regulatory considerations presented above.

The remainder of this section presents the site-specific monitoring parameters. These lists correspond to an alternate monitoring program parameters list as defined in the regulations. It is thought that these indicator parameters will provide sufficient and reliable indication of potential releases throughout the operation of the OSDF. However, future considerations for potential modifications of the parameter list are also discussed at the end of Section 4.4.3.

4.4.2 Initial Leak Detection Monitoring Parameters List

An alternate leak detection monitoring parameters list should include both primary (i.e., chemical-specific) parameters and supplemental indicator parameters. As suggested by the regulatory considerations summarized in Table 4-1, primary parameters should consist of selected site-specific chemical constituents which are expected to be of significant amounts in the monitored facility, and which are persistent, mobile, and differentiable from existing background conditions when released. The supplemental indicator parameters may include general groundwater quality parameters, which will have rapid and detectable changes in response to variations in chemical compositions in groundwater under the monitored facility, potentially as a result of a leak.

Fourteen primary parameters and four supplemental indicator parameters are proposed for the initial groundwater leak detection monitoring for the OSDF (i.e., baseline monitoring). Samples collected in the perched groundwater and Great Miami Aquifer monitoring wells for the initial baseline analyses, as well as samples collected in all four monitoring components during and after waste placement, will be analyzed for these 18 parameters. This subsection presents the rationale for the selection of the primary and supplemental indicator parameters.

4.4.2.1 Primary Parameters

In general, organic constituents are more mobile but less persistent than most inorganic constituents and radionuclides. Because inorganic constituents and most radionuclides are present in natural soil, if the OSDF was constructed in a pristine site, organic constituents may be the preferred primary monitoring parameters for early leak detection purposes. However, because all three types of constituents have been detected in the media (i.e., perched groundwater and the Great Miami Aquifer), in order to be differentiable from background conditions in case of a release, a good leak detection monitoring parameter must also be present in significant abundance or at relatively high source strengths in the OSDF.

Constituent-specific quantity, persistence, and mobility data were considered during the development of the WAC for the OSDF. Therefore, information from the OSDF WAC development process was first reviewed to select the primary parameters for leak detection monitoring purposes. The WAC for the OSDF were developed for 42 constituents during the Operable Unit 5 FS; 41 of the WAC are included in the final Operable Unit 5 Record of Decision (as discussed later, one compound, magnesium, was eliminated following completion of the FS). As discussed in this section, 18 of the 41 WAC are numerical limits and 23 are non-numerical limits that were established to satisfy regulatory screening criteria for RCRA-regulated constituents.

The maximum acceptable leachate concentrations for constituents that will be present in the OSDF were determined by fate and transport modeling. The constituent-specific leaching potential, solubility, mobility, and benefits of the engineering controls in the OSDF were considered in the modeling process. These maximum acceptable leachate concentrations were converted into solid phase WAC at the end of the process. These solid phase WAC represent the maximum concentrations for soil and debris that can be disposed of in the OSDF.

To assist in selecting the primary parameters, the actual soil concentrations for each of the 18 constituents of concern (COCs) for which numerical WAC were developed are also reviewed in order to provide a clear perspective regarding which COCs may approach their corresponding WAC concentrations and therefore are more likely to be detectable when released from the OSDF.

During the Operable Unit 5 FS, two categories of COCs were evaluated in the WAC development process. The first category includes all site-specific groundwater pathway COCs that were identified in the Operable Unit 5 RI. As a result of the process, 12 numerical WAC were developed for the groundwater pathway COCs. The second category includes those Fernald site constituents that need to be managed and accounted for under RCRA regulations. Six additional numerical WAC were developed for the RCRA-regulated constituents, bringing the total numerical WAC for the OSDF to 18. The following subsections summarize the WAC development process for these two categories of constituents, as derived from the sitewide WAC development process described in the Operable Unit 5 FS. Figure 4-6 summarizes the process in flow chart fashion.

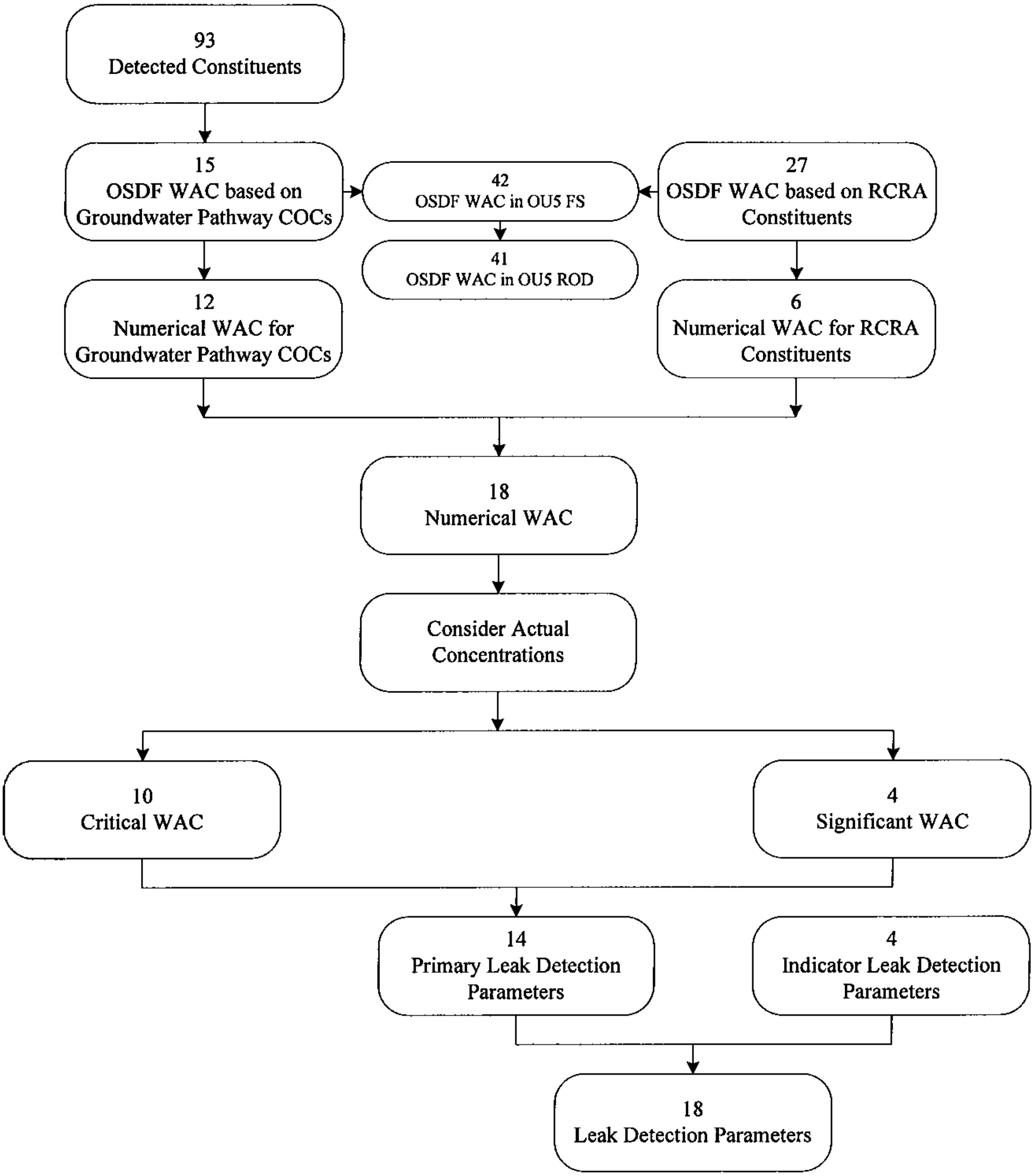


Figure 4-6. Groundwater/Leak Detection Parameter Selection Process

4.4.2.1.1 Groundwater Pathway COCs

Initially, only the WAC for groundwater pathway COCs were developed. WAC were determined necessary for 15 groundwater pathway COCs selected from Table F.2-2 of Appendix F of the Operable Unit 5 FS. Among all the detected soil and groundwater constituents at the Fernald site, these 15 COCs have potential to reach and impact the Great Miami Aquifer through the glacial till under natural conditions (i.e., before being disposed in the OSDF) within 1000 years. Table F.2-2 also lists all the other constituents screened for potential cross-media impacts. Overall 53 organics, 25 inorganics, and 15 radionuclides were evaluated in the groundwater COC selection process, including all the RCRA constituents that have been detected in soil and groundwater at the Fernald site.

After considering the engineering controls provided by the OSDF in the modeling procedures, 12 of the original 15 groundwater pathway COCs were found to require a numerical WAC. Compliance with the 12 numerical WAC, when determining what materials can be disposed in the OSDF, will be required for long-term protection of the Great Miami Aquifer. Table 4-2 lists the 15 COCs considered and the WAC that were developed. The technical approach of fate and transport modeling conducted to develop the COC-specific WAC has been summarized in Section F.5 in the Operable Unit 5 FS.

Upon further review of the initial WAC development process contained in the Operable Unit 5 FS, EPA, OEPA, and DOE concurred that magnesium does not present a significant threat to human health. Therefore, magnesium was eliminated from further consideration and a WAC for magnesium was not presented in Table 9-6 of the Operable Unit 5 Record of Decision.

The numerical WAC for the 12 groundwater pathway COCs will likely be the main controlling factors for the disposal of contaminated soil in the OSDF. The 12 groundwater pathway COCs, which have numerical WAC, have significantly higher mobility and persistence, and therefore should be considered as prime candidates when selecting the indicator parameters for the detection monitoring program for the OSDF.

The numerical WAC for the 12 groundwater pathway COCs in Table 4-2 only define the maximum allowable soil concentrations that can be safely disposed of in the OSDF; they do not indicate what level of soil concentrations will actually be encountered during soil remediation. In order to frame the relative significance of these 12 WAC, the maximum soil concentrations for the 12 constituents that are expected in the OSDF following soil placement are provided in Table 4-3.

TABLE 4-2

WAC FOR GROUNDWATER PATHWAY COCS

COC	WAC
Radionuclides (pCi/g):	
Neptunium-237	3.12×10^{9}
Strontium-90	5.67×10^{10}
Technetium-99	2.91×10^{1}
Total uranium - (mg/kg)	1.03×10^{3}
Organics (mg/kg):	
Alpha-Chlordane	2.89×10^{0}
Bis(2-chloroisopropyl)ether	2.44×10^{-2}
Bromodichloromethane	9.03×10^{-1}
Carbazole	7.27×10^{4}
1,2-Dichloroethane	*
4-Nitroaniline	4.42×10^{-2}
Vinyl Chloride[1]	1.51×10^{0}
Inorganics (mg/kg):	
Boron	1.04×10^{3}
Chromium VI[1]	*
Magnesium	*
Mercury[1]	5.66×10^{4}

*Denotes constituents that will not exceed designated Great Miami Aquifer action level within 1000-year performance period, regardless of starting concentration in the disposal facility.
[1]RCRA constituent.

TABLE 4-3

EXPECTED MAXIMUM COC CONCENTRATIONS IN THE OSDF

COC	Maximum Concentration[1]	WAC	MAX/WAC
Radionuclides (pCi/g):			
Neptunium-237	2.63×10^{0}	3.12×10^{9}	8.43×10^{-10}
Strontium-90	6.49×10^{0}	5.67×10^{10}	1.14×10^{-10}
Technetium-99	2.91×10^{1}	2.91×10^{1}	1.00×10^{0}
Total uranium - (mg/kg)	1.03×10^{3}	1.03×10^{3}	1.00×10^{0}
Organics (mg/kg):			
Alpha-Chlordane	5.10×10^{-3}	2.89×10^{0}	1.76×10^{-3}
Bis(2-chloroisopropyl)ether	2.44×10^{-2}	2.44×10^{-2}	1.00×10^{0}
Bromodichloromethane	7.00×10^{-3}	9.03×10^{-1}	7.75×10^{-3}
Carbazole 2.50×10^{-1}	7.27×10^{4}	3.44×10^{-6}	
4-Nitroaniline 4.42×10^{-2}	4.42×10^{-2}	1.00×10^{0}	
Vinyl Chloride[2]	1.51×10^{0}	1.51×10^{0}	1.00×10^{0}
Inorganics (mg/kg):			
Boron	1.43×10^{1}	1.04×10^{3}	1.38×10^{-2}
Mercury	1.30×10^{0}	5.66×10^{4}	2.30×10^{-4}

[1]Lower value between the WAC and the maximum soil concentration presented in Table F.3.4-3, Operable Unit 5 RI.
[2]Also consider tetrachloroethene and trichloroethene in soil.

As shown in Table 4-3, the expected maximum soil concentrations in the OSDF reveal that only five of the 12 groundwater pathway COCs with numerical WAC (technetium-99, total uranium, vinyl chloride, bis(2-chloroisopropyl)ether, and 4-nitroaniline) are expected to approach their respective WAC concentrations. The other seven COCs will have maximum soil concentrations in the OSDF that are much less than their corresponding WAC. This information regarding overall abundance is also an important consideration for selecting indicator parameters for the leak detection monitoring program.

4.4.2.1.2 RCRA Constituents

After the WAC for the groundwater pathway COCs were developed, WAC for 27 additional RCRA-regulated constituents (termed the RCRA COCs) were evaluated. Development of WAC for these specific constituents was considered necessary from a regulatory standpoint to address a requirement that the RCRA COCs not be eliminated in any COC screening step during the RI/FS process. The intention was to demonstrate compliance with RCRA regulations by providing a mechanism for keeping track of the fate of materials contaminated with RCRA constituents during the remediation.

the additional constituents were determined to need a numerical WAC. The details of the RCRA constituent WAC development process are provided in Attachment F.5.I of the Operable Unit 5 FS. Table 4-4 summarizes the results.

The six additional numerical WAC in Table 4-4 are actually not expected to affect any disposal decisions for contaminated waste, soil, and debris from Operable Units 2, 3, and 5. As shown in Table 4-4, the WAC for chloroethane and toxaphene are close to pure product concentration (i.e., 1.00×10^6 milligrams per kilogram [mg/kg]). The WAC for tetrachloroethene, trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethene are higher than the highest detected soil concentrations, which were used in the previous screening process summarized in Table F.2-2 of the Operable Unit 5 FS. The maximum detected soil concentrations presented in Table F.3.4-3 of the Operable Unit 5 RI for tetrachloroethene, trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethene are 1.6×10^0, 8.90×10^1, 3.90×10^{-2}, and 3.4×10^{-1} mg/kg, respectively.

In general, the 15 groundwater pathway COCs listed in Table 4-2 already include all the constituents detected in soil and groundwater at the Fernald site which may have potential to impact the Great Miami Aquifer and, therefore, are more likely to be detectable in the monitoring system in case of a leak from the OSDF.

4.4.2.1.3 <u>Selected Primary Parameters</u>

Based on information presented in Tables 4-2 through 4-4, 14 constituents are considered to be the initial primary parameters list for OSDF leak detection monitoring purposes. Table 4-5 summarizes these constituents and the rationale for their selection. Table 4-5 also indicates whether each of the 14 constituents is listed in OAC 3745-27-10 Appendix I as a regulatory default parameter.

Four of the 18 constituents which have numerical WAC listed in Tables 4-2 or 4-4 (i.e., chloroethane, toxaphene, neptunium-237, and strontium-90) were not selected because of their expected actual maximum concentrations in the OSDF and their comparatively high WAC values which indicate less likely potential impacts and detectability in case of a leak from the OSDF. However, four RCRA constituents which are not groundwater pathway COCs (i.e., tetrachloroethene, trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethene) were selected since their expected maximum soil concentrations are reasonably close to the WAC.

TABLE 4-4

WAC FOR ADDITIONAL RCRA CONSTITUENTS

RCRA Constituents	Detected and Previously Screened	WAC	OAC 3745-27-10 Appendix I
Organics (mg/kg):			
Acetone	yes	*	Yes
Benzene	yes	*	Yes
Carbon tetrachloride	yes	*	Yes
Chloroethane	no	3.92×10^5	Yes
Chloroform	yes	*	Yes
Chloromethane	no	*	Yes
1,1-Dichloroethane	yes	*	Yes
1,1-Dichloroethene	yes	1.14×10^1	Yes
1,2-Dichloroethene	no	1.14×10^1	Yes
Endrin	no	*	No
Ethylbenzene	yes	*	Yes
Heptachlor	no	*	No
Heptachlor epoxide	no	*	No
Hexachlorobutadiene	no	*	No
Methoxychlor	no	*	No
Methylene chloride	yes	*	Yes
Methyl ethyl ketone	yes	*	Yes
Methyl isobutyl ketone	no	*	Yes
Tetrachloroethene	yes	1.28×10^2	Yes
1,1,1-Trichloroethane	yes	*	Yes
Trichloroethene	yes	1.28×10^2	Yes
Toluene	yes	*	Yes
Toxaphene	no	1.06×10^5	No
Xylenes	yes	*	Yes
Inorganics (mg/kg):			
Barium	yes	*	Yes
Lead	yes	*	Yes
Silver	yes	*	Yes

*Denotes constituents that will not exceed designated Great Miami Aquifer action level within 1000-year performance period, regardless of starting concentration in the disposal facility.

TABLE 4-5

PROPOSED PRIMARY PARAMETERS LIST

Constituents of Concern	Rationale	Appendix I
Radionuclides (pCi/g):		
Technetium-99	likely detectable when released	No
Total uranium - (mg/kg)	likely detectable when released	No
Organics (mg/kg):		
Alpha-Chlordane	likely detectable when released	No
Bis(2-chloroisopropyl)ether	likely detectable when released	No
Bromodichloromethane	likely detectable when released	Yes
Carbazole	likely detectable when released	No
1,1-Dichloroethene	significant RCRA constituent	Yes
1,2-Dichloroethene	significant RCRA constituent	Yes
4-Nitroaniline	likely detectable when released	No
Tetrachloroethene	significant RCRA constituent	Yes
Trichloroethene	significant RCRA constituent	Yes
Vinyl Chloride	likely detectable when released and significant RCRA constituent	Yes
Inorganics (mg/kg):		
Boron	likely detectable when released	No
Mercury	likely detectable when released and significant RCRA constituent	No

The 14 constituents identified in Table 4-5 that were selected as the primary leak detection monitoring parameters have a potential of entering the environment in measurable quantities and are likely to be more differentiable from background conditions. These 14 constituents will provide a reliable indication of potential releases from the OSDF to the groundwater.

4.4.2.2 Supplemental Indicator Parameters

In addition to the primary parameters discussed in the preceding subsection, four general groundwater contamination indicator parameters were also proposed to supplement the selected chemical constituents in the initial leak detection monitoring parameters list. These supplemental indicator parameters are comprised of the following:

- pH;
- Specific Conductance;
- Total Organic Halogens (TOX); and
- Total Organic Carbon (TOC)

These general groundwater contamination indicator parameters are typically used to aid in the detection of releases from disposal facilities. These supplemental indicator parameters provide an added means to detect contaminant migration, and will be useful as indicators for general groundwater quality degradation.

Although the initial indicator parameters will likely provide sufficient and reliable indications of potential releases throughout the operational life of the OSDF, efficiency of the parameters list may still be improved based on the collected data obtained over the course of the program. Any proposed modifications based on the accumulated database will involve EPA and OEPA review and approval before adoption, as discussed below.

4.4.3 Parameter List Modifications

The sections above identify the process for selecting parameters for initial baseline sampling and analysis (i.e., leak detection indicator parameters). It is anticipated that during the data collection process for OSDF, recommended refinements to the monitoring lists will be made periodically. These recommendations will either be made as part of the annual review process (which is documented in the annual site environmental reports), or included in the technical memoranda (which document the establishment of baseline conditions). All changes will be approved by EPA and OEPA prior to implementation. To date, the following changes have been recommended, approved, and implemented.

The Technical Memorandum for the On-site Disposal Facility Cells 1, 2, and 3 Baseline Groundwater Conditions documented the results of baseline groundwater monitoring activities through December 2000. The results indicated that it would be appropriate for Cells 1, 2, and 3 post-baseline monitoring to focus on the four constituents that had sufficient number of detections to allow for statistical analysis. The four constituents are total organic carbon, total organic halogens, boron, and total uranium.
Beginning in August 2002, analysis for these constituents has been performed quarterly in the LCS, LDS, horizontal till well, and the Great Miami Aquifer wells for Cells 1, 2, and 3. In addition, as recommended in the technical memorandum, all leak detection indicator constituents are analyzed in the annual samples collected from Cells 1, 2, and 3 LCS and LDS. If a constituent is detected in either the LCS or LDS, then confirmatory sampling for that constituent will consist of three consecutive quarterly samples from the horizon in which it was detected. Depending on the magnitude and/or persistence of the constituent detected in the LCS or LDS, sampling for the detected constituent in the next lower horizon may occur. If the constituent is detected in the next lower horizon, then confirmatory sampling will again be conducted

for three consecutive quarters. This strategy, performed as necessary, is based on detected constituents to ensure that a thorough evaluation of all detected constituents is completed.

With respect to the commitment identified in the technical memorandum, the 2003 annual sample collection at Cells 1 through 3 for the site-specific leak detection indicator parameters coincided with the annual sampling of the LCS identified above. For 2003 there was one detection for 4-nitroaniline of 1.01 μg/L from the Cell 1 LCS which was below the contract required detection limit of 5 μg/L, as well as the estimated quantitation limit of 20 μg/L listed in the method. Due to the very low estimated detected concentration, it was determined that confirmatory sampling was not necessary; however, this constituent will be analyzed again in 2004 along with the other annual analyses. Additionally, technetium-99 was detected at the Cell 3 LCS (9.89 pCi/L). Confirmatory sampling of technetium-99 in the Cell 3 LCS began in the first quarter of 2004 and will continue for the following two quarters. Data will be evaluated as they are available and a determination will be made regarding continued sampling.

In 2002 there were relatively high concentrations of sulfate in the Cells 4 and 5 LCS water prior to waste placement, indicating a sulfate source (possibly gypsum) in the gravel comprising the LCS layer. Due to sulfate's high mobility and the presence of an ongoing source in the LCS/LDS layers, it was identified as a leak detection indicator parameter and added to the monitoring requirements at all OSDF locations beginning in 2003 (refer to Appendix B for monitoring frequencies in each cell).

An additional subsequent future re-evaluation of the program (e.g., a review of monitoring results accompanying final capping) is envisioned before the long-term, post-closure leak detection monitoring parameters list is ultimately finalized. The following subsections also describe some of the considerations of future additions and deletions to the parameter lists. As previously mentioned, all additions and deletions to the indicator list will be identified to EPA and OEPA and approved prior to implementation. Variances and revisions to the Project-Specific Plan and this plan will be made as necessary.

4.4.3.1 Eliminating Monitoring Parameters

An indicator parameter will be considered for elimination from the current program (or the long-term leak detection monitoring parameters list) when the baseline data indicate significant fluctuations and/or very high concentrations in horizontal till or Great Miami Aquifer monitoring wells. When the baseline concentrations of a constituent are high, a leak from the OSDF may not be noticeable from monitoring results due to background interferences. When the background concentrations fluctuate significantly, there will be a high chance of a false positive of a leak. In either case the constituent cannot be considered a reliable indicator for leak detection purposes. Additionally, those constituents that do not have a significant percentage of detectable concentrations in samples collected to establish baseline conditions will be recommended for elimination of post-baseline monitoring.

An indicator parameter will also be considered for elimination from the long-term leak detection monitoring parameters list if it is not detected in the LCS leachate samples collected during active waste placement. Any constituents not detected in the LCS leachate samples after waste placement are likely to be absent, insoluble, or of insignificant abundance in the OSDF. Therefore, it may not be necessary to analyze these constituents further for leak detection purposes, and a proposal for EPA and OEPA approval of the constituents' elimination will be developed.

4.4.3.2 Adding Monitoring Parameters

Based on the analytical results of the annual grab sample of leachate collected in LCS for the Appendix I and PCB parameters specified in OAC 3745-27-10 and 19 (see Section 5.0 for more details), detected constituents will be evaluated to determine whether the original indicator parameters list is sufficient for leak detection purposes. As mentioned before, most of the Appendix I constituents have already been detected in perched groundwater under the Fernald site and were considered when selecting the initial leak detection indicator parameters. It is expected that these constituents will also be detected in future OSDF leachate samples. However, they will not necessarily be adequate indicators of a release. Therefore, constituents detected in the annual OSDF LCS samples will not be automatically added to the leak detection indicator parameters list, unless they meet the criteria discussed below.

The need to add a new indicator parameter will be considered when its detected concentrations in the annual OSDF LCS samples are much higher than the concentrations that exist currently in the contaminated media underlying the facility (which were evaluated during the initial parameter selection process). An indicator parameter will be added when it can be demonstrated that routine analysis of the constituent in the leak detection monitoring system can significantly enhance the early detection capability of the monitoring program. Evaluations of the annual leachate grab sampling data will be conducted to determine the need for adjustments to the current parameter list; the results of the evaluations will be reported in accordance with the OAC 3745-27-19(M) reporting requirement.

As indicated in Section 3.2.2, although constituents which are not part of the limited indicator parameter list for leak detection may be detected in the annual grab, it is not anticipated that the concentrations will be high enough to warrant revision of the leak detection parameter list. However, a review of the data will be conducted (and reported through the annual site environmental reports) to determine whether any new indicator constituents should be added to the site-specific leak detection indicator parameter list. A constituent will be added if: (1) concentrations observed in the annual sample are much higher than the perched water concentrations at the Fernald site; and (2) routine analysis of the constituent can significantly enhance early detection capability. Additions will be documented through the annual site environmental reports.

4.5 LEAK DETECTION SAMPLE COLLECTION

The following subsections discuss the sample collection for the four components of the leak detection program: the LCS and LDS drainage layers (flow and water quality), the horizontal till wells in the glacial till (water quality), and the monitoring wells in the Great Miami Aquifer (water quality). The subsections discuss the establishment of baseline conditions in the perched groundwater and Great Miami Aquifer, and post-baseline sampling that will accompany all four components during active cell operations and after each cell is capped.

4.5.1 Establishment of Baseline Conditions

In order to accurately determine whether there has been a leak from the OSDF, it is necessary to establish representative baseline conditions in the natural environment underlying the facility, from which to draw future comparisons. As discussed in Section 2.0, both the perched groundwater system and the Great Miami Aquifer in the vicinity of the OSDF contain uranium and other Fernald site-related constituents at levels above background. Many of these constituents are also included in the OSDF analytical parameter list discussed in Section 4.4. It is therefore important to establish pre-existing conditions (i.e., constituent concentration levels and variability) for all of the OSDF analytical parameters so that accurate assessments of future data trends in the perched system and the Great Miami Aquifer can be made.

The Fernald site's existing information concerning pre-existing contaminant conditions in the subsurface is derived from the Operable Unit 5 RI and the OSDF Pre-Design Investigation. This existing information has been sufficient for the purposes of risk assessment, the development of conceptual and detailed designs for the Fernald site's remedial actions, and the formulation of conservative assumptions for fate and transport modeling. The existing information is not of such detail, however, to permit the statistical evaluations, precise spatial and temporal comparisons, and comprehensive data trending that accompanies a leak detection program. More information regarding data variability and seasonal influences is needed in the immediate vicinity of the OSDF for both the perched system and the Great Miami Aquifer.

As indicated in Section 3.0, the Ohio Solid Waste regulations require that, for detection monitoring, at least four independent samples be taken from each well to determine the baseline water quality during the first 180 days after implementation of the groundwater detection monitoring program (OAC 3745-27-10(D)(5)(a)(ii)*(a)*). Note that baseline monitoring may possibly continue after initiation of waste placement and during active cell operations. Appendix B is the Project-Specific Plan, which includes sampling frequencies for each specific cell where baseline/background conditions need to be established.

For both the perched groundwater and Great Miami Aquifer wells, once the data from the initial sampling events have been procured, DOE will evaluate whether sufficient information is available to establish baseline. At this juncture, an appropriate statistical method and associated statistical measure to establish pre-existing baseline conditions will be selected. This identification is anticipated to be made on a cell-specific basis for both the perched groundwater and Great Miami Aquifer components of the program. If the amount of data is insufficient for this purpose, additional baseline samples will be collected. The initial planned sampling intervals will be scheduled far enough in advance of waste placement to allow for additional sampling if necessary to augment the baseline database.

In the event that one or more monitoring points (for example, the perched water wells) produce insufficient water volume for sampling the full suite of analytical parameters, the data accumulation period for establishing that monitoring point's baseline might be extended (at a sampling frequency independent of the frequency for the other monitoring points which have a baseline) until sufficient data are obtained for that monitoring point.

This approach and frequencies (identified in Appendix B) exceed the minimum State of Ohio regulatory requirements for background sampling and should provide sufficient information to conduct future comparative evaluations.

4.5.2 Post-Baseline Monitoring (During Active Cell Operations and After Cells are Capped)

Flow measurements and water quality analysis for the LCS and LDS commence after waste placement is initiated. Post-baseline monitoring of the Great Miami Aquifer and perched water commence after baseline conditions have been established.

As identified in Section 3.2.1.4, the Ohio Solid Waste regulations require a semiannual sampling frequency for detection monitoring but also allow for the proposal of an alternate sampling program (OAC 3745-27-10(D)(5)(a)(ii)*(b)* and (b)(ii)*(b)*, and 3745-27-10(D)(6)). During active cell operations (more specifically, post-baseline monitoring prior to cell capping), the sampling frequency for the OSDF groundwater/leak detection monitoring program will be quarterly for the indicator parameters, which exceeds the semiannual frequency requirement. After each cell is capped, it is anticipated that site-specific leak detection indicator parameter monitoring for each of the four components (i.e., LCS, LDS, horizontal till well, and Great Miami Aquifer wells) will be performed semiannually to continue to meet regulatory requirements. It is anticipated that final capping of the individual cells will generally result in a decrease in the overall quantity of leachate produced and a potential corresponding change in leachate composition.

4.5.2.1 Flow Monitoring in the LCS and LDS

Leachate collected by the LCS from each cell flows by gravity to the Enhanced Permanent Leachate Transmission System (EPLTS) permanent lift station. Anticipated leachate production rates in the LCS were determined during the design of the OSDF (see Section 7.1 of the OSDF Calculation Package [GeoSyntec 1997]) as follows:

	LCS, each cell, gallons per acre day		LCS, baseline design flow rate per cell, gallons per day
	Average	Peak	
Initial stage (10 ft. or less waste)	1,145	1,754	
Intermediate stage (>10 ft. of waste)	696	1,754	11,401
After closure	0.002	0.024	0.16

The initial stage is when construction of the liner system has been completed, and waste placement starts and continues until 10 feet of waste has been placed in the cell. The intermediate stage is the placement of waste from the initial 10 feet of waste until cell closure. After closure is the period after the cell has been capped.

The amount of liquid removed from the OSDF via the LCS is recorded in accordance with the graded approach depicted below. This graded approach is patterned after federal hazardous waste landfill regulation 40 CFR 264.303(c)(2), and also satisfies Ohio solid waste rule OAC 3745-27-19(M)(4):

Tier	LCS Flow Monitoring Frequency
Prior to Placement of Final Cover on the Last OSDF Cell	
0	Record at least monthly.
Post Closure (After Placement of Final Cover on the Last OSDF Cell)	
1	Record at least monthly, except as provided by the following.
2	If the liquid level stays below the "pump operating level" for two consecutive months, record at least quarterly, except as provided by the following.
3	If the liquid level stays below the "pump operating level" for at least two consecutive quarters, record at least semiannually.

NOTE: The post-closure point of measurement is the EPLTS permanent lift station. If at any time during the post-closure care period the "pump operating level" is exceeded when on quarterly (Tier 2) or semiannually (Tier 3) recording schedule, the recording schedule will revert to monthly (Tier 1) until the requirement is met to move to the next higher numbered tier.

"Pump operating level" is that liquid level based on pump activation level, sump dimensions, and the level that avoids backup into the LCS drainage layers in the OSDF cells, and minimizes head in the EPLTS permanent lift station. The pump operating level for the EPLTS permanent lift station is to be developed later (as discussed in Section 6.0) after the final cover has been placed over the last cell of the OSDF. It is anticipated that this will be established via trend analysis on leachate flow monitoring measurements prior to and after closure of the last cell of the OSDF.

Additionally, trend analyses of these LCS flow monitoring measurements are conducted on those cells that are capped in order to provide indication of changes in trends in system performance far enough in advance to allow application of appropriate follow-up inspection and corrective action as necessary. The required notifications and response actions for leachate flow monitoring are discussed in Section 6.0.

The amount of liquid removed from each LDS is recorded in accordance with the following graded approach, consistent with the approach for the LCS:

Tier	LDS Flow Monitoring Frequency
Prior to Placement of Final Cover on an Individual OSDF Cell	
0	Record weekly.
Post Closure (After Placement of Final Cover on an Individual OSDF Cell)	
1	Record at least monthly, except as provided by the following.
2	If the liquid level in the LDS stays below the "action leakage rate" for two consecutive months, record at least quarterly, except as provided by the following.
3	If the liquid level in the LDS stays below the "action leakage rate" for at least two consecutive quarters, record at least semiannually.

NOTE: These are intended to apply individually to each cell of the OSDF. If at any time during the post-closure care period the "action leakage rate" is exceeded at a cell on quarterly (Tier 2) or semiannually (Tier 3) recording schedule, the recording schedule for that cell will revert to monthly (Tier 1) until the requirement is met to move to the next higher numbered tier.

"Action leakage rate" is that liquid level based on LDS collection tank dimensions, and the level that avoids backup into the LDS drainage layer. The action leakage rate for each LDS collection tank is to be developed later (as a future amendment to this plan, and as discussed in Section 6.0) based on measurements after the final cover has been placed over that cell. It is anticipated that this action leakage rate will be established via trend analyses on closed cells prior to closure of the last cell of the OSDF. (Refer to Plates M-1 through M-7 from the October 2001 EPLTS drawings [Cells 1 – 6] and Plates M-1 through M-6 from September 2003 Valve House 7/8 drawings [Cells 7 and 8] for the configuration of valve houses and associated LDS collection tanks.)

Additionally, trend analysis of the LDS flow monitoring measurements are conducted on those cells that are capped in order to provide an indication of changes in trends in system performance far enough in advance to allow application of appropriate follow-up inspection and corrective action as necessary. The required notifications and actions are discussed in Section 6.0.

4.5.2.2 Water Quality Monitoring in the LCS and LDS

During active cell operations, water quality monitoring for the LCS and LDS drainage layers within each cell (for leak detection monitoring purposes) is performed quarterly. The samples will be analyzed for parameters contained in Section 4.4; more specifically, those identified in the Project-Specific Plan provided in Appendix B.

Prior to collecting the sample, the volume contained in the LCS and LDS tanks or flowing through the individual LCS and LDS transfer lines is estimated to determine whether sufficient volume is present for the full suite of analytes (see discussion in Appendix B for the setting of priorities). In case there is an absence of liquid in the LCS and/or LDS drainage layers such that water quality sampling cannot be conducted, it will be inferred that no leak from the cell has occurred.

While it is desired that the samples be collected from the LCS and LDS during the same time interval to enhance the comparability of the data, the overriding requirement is that enough fluid be present in the individual system to collect sufficient volume for the analyses.

As identified above, after each cell is capped it is anticipated that water quality monitoring for indicator parameters will be conducted semiannually to continue to meet regulatory requirements.

4.5.2.3 Water Quality Monitoring of the Perched Groundwater and Great Miami Aquifer

After the perched groundwater and Great Miami Aquifer baselines are established, the groundwater monitoring wells for both of these components are sampled quarterly (during active cell operations) to address the potential for seasonal variation in the analytical parameters. Four quarters of sampling over one year are generally accepted for providing seasonal variation in groundwater chemistry. Because of the existing contamination in the Great Miami Aquifer and the perched groundwater, and the current remediation activities underway site-wide, the sampling frequency is quarterly until future conditions warrant otherwise. The samples will be analyzed for parameters contained in Section 4.4 (more specifically, those parameters identified in the Project-Specific Plan provided in Appendix B).

Sampling both the perched groundwater and the Great Miami Aquifer groundwater during the same time frame is desired in order to enhance the comparability of the data; however, the overriding requirement is that enough fluid be present in the individual monitoring point to collect sufficient volume for the analyses.

Prior to collecting the sample, the volume contained in the monitoring point is estimated in order to determine whether sufficient volume is present for the full suite of analytical parameters (see Appendix B for a discussion on setting priorities for low sample volume). The sufficiency of volume is of particular concern in the till monitoring point; if no liquid is found in the till monitoring point, it will be inferred that no leak from the cell has occurred. However, if water exists in the well, it will not be inferred that a leak has occurred, and water volume measurements will be taken and plotted versus time in order to assist in the holistic approach of determining a leak.

As identified above, after each individual cell is capped, it is anticipated that water quality monitoring for indicator parameters will be conducted semiannually to continue to meet regulatory requirements.

4.6 LEAK DETECTION DATA EVALUATION PROCESS

The leak evaluation strategy for each OSDF cell is two-fold:

- Trend analysis for the LCS, LDS, the glacial till, and the Great Miami Aquifer will help pinpoint potential leak-related influences within each leak detection program element; and
- The monitoring results from all elements will be correlated and evaluated holistically to determine whether a release has occurred and if a response action is necessary.

These components are discussed in the next two sections.

4.6.1 Trend Analysis

The initial flow and water quality data obtained from the LCS, LDS, and the groundwater monitoring components are used to begin a qualitative trend analysis of the volume of leachate produced by each cell and the corresponding concentrations of analytes in each monitoring component. Each cell is evaluated independently; consequently, an "intra-well" trend analysis will be used. As part of the establishment of baseline conditions, an identification of an appropriate statistical method for the trend analysis is made following the receipt and review of all baseline data. The identified method will be presented to EPA and OEPA for approval at the conclusion of the baseline activity. The type of statistical method is selected after sufficient sampling events have been completed for each baseline, and is provided in a technical memorandum to the EPA and OEPA for approval. Control charts have been the statistical method of choice for Cells 1 through 3.

The intra-well trend analysis approach can be applied to data from all the elements — the LCS, LDS, and the groundwater monitoring components. This approach is most advantageous; however, there are issues associated with groundwater given the inherent difficulties in distinguishing potential releases from the OSDF from existing above-background levels of monitoring constituents in the area of the OSDF. Regardless, point-by-point intra-well trending comparisons will be performed for the Great Miami Aquifer wells and horizontal till wells.

As indicated above in Section 4.5.2.1, action leakage rate(s) for the LDS are to be developed later after the final cover has been placed over the last cell of the OSDF. The pump operating level for the EPLTS permanent lift station will also be developed later, based on measurements after the final cover has been placed over the last cell of the OSDF. It is anticipated that this will be established via trend analysis on LCS flow monitoring measurements prior to and after closure of the last cell of the OSDF.

4.6.2 Correlation of Monitoring Data

If liquid is collected from the LDS, it does not necessarily mean that the OSDF's leachate is leaking through the primary liner into the LDS. Liquid in the LDS could be from sources other than from within a particular cell. To determine whether liquid in the LDS is leachate and the primary liner of a cell is leaking, a correlation must exist between the LCS and LDS analyte concentrations. A correlation must also exist between the increases in volume of liquid in the LCS and the LDS ("flow monitoring data"). If volume increases and analyte concentrations between the two systems correlate, then a leak through the primary composite liner system will be suspected. The significance of the suspected leak with regard to the protection of the environment depends on the concentrations of the analytes found in the LDS and the volume of liquid present. Analyte concentrations and volume-versus-time plots of groundwater collected from the till monitoring wells will be correlated with LCS and LDS data to detect a leak in the secondary composite liner system that contains the three-foot compacted clay liner.

The primary purpose for the data collected in the Great Miami Aquifer is to establish a baseline from which to determine if leakage from the OSDF is detrimentally affecting the Great Miami Aquifer. It is recognized that an exhaustive characterization of the Great Miami Aquifer has already been conducted from which to determine Fernald site impacts (from sources other than the OSDF), and to establish Fernald site-specific constituents of concern and associated final remediation levels. From this, a protective remedy for the Great Miami Aquifer has been developed, the success of which will be tracked through IEMP monitoring of site-specific indicator constituents. This has been documented in the Operable Unit 5 RI and FS Reports, the Operable Unit 5 Record of Decision, and the IEMP.

A secondary purpose for the Great Miami Aquifer data collected through the OSDF monitoring plan is to supplement the IEMP remedy performance monitoring data that will be collected for the aquifer. Groundwater data for those OSDF leak detection constituents that are also common to the IEMP groundwater remedy performance constituents are used in the IEMP data interpretations as the data become available. Groundwater data collected for those unique OSDF leak detection constituents which are not being monitored by the IEMP groundwater monitoring program are used only for the establishment of the OSDF baseline and subsequent leak detection monitoring.

5.0 LEACHATE MANAGEMENT MONITORING PROGRAM

As discussed in Section 3.0, the Ohio Solid Waste Disposal regulations require an overall leak detection strategy to comply with the leachate management and monitoring requirements in OAC 3745-27-19(M)(4) and OAC 3745-27-19(M)(5). To fulfill these requirements, the leachate management monitoring strategy provides:

1. A means to track the quantity of leachate collected for treatment and discharge, reported at least monthly;
2. A means to verify that the engineering components of the leachate management system will operate in accordance with OAC 3745-27-19, Operational Criteria for a Sanitary Landfill Facility;
3. A description of the site-specific leachate treatment and discharge elements to ensure that the leachate collected from the facility is properly managed; and
4. Collection and analysis of an annual leachate grab sample for Appendix I and PCB parameters per OAC 3745-27-10 and 19 to confirm, on an ongoing basis, the adequacy and appropriateness of the selected site-specific leak detection indicator parameters.

Item 1 of the requirements above is fulfilled by the flow monitoring component of the leak detection monitoring strategy. Flow measurements will take place at least monthly during active cell operations for both the LCS and LDS drainage layers (see Section 4.5.2.2). Item 2 of the requirements above is fulfilled by Section 3.0 of the OSDF Systems Plan, which describes the operation and maintenance activities for the OSDF's leachate management system to be employed during active cell operations.

Items 3 and 4 are described in Sections 5.1 and 5.2, respectively. Additionally, item 4 is discussed in Section 4.0 (e.g., Section 4.4.3.2).

5.1 LEACHATE TREATMENT AND DISCHARGE MANAGEMENT

All leachate from the OSDF is currently treated within the on-site AWWT facility prior to discharge at a National Pollutant Discharge Elimination System (NPDES)-permitted outfall to the Great Miami River (PF 4001). Current plans are to convert the AWWT facility (CAWWT) as waste stream treatment requirements are eliminated and remediation proceeds. Following completion of the CAWWT, leachate will be treated in the CAWWT and will be discharged at the NPDES-permitted outfall to the Great Miami River. Modifications to the treatment process included in the CAWWT design will ensure that the same unit treatment processes are used for treatment of leachate. Following is a description of the management approach for leachate treatment, along with a description of the treatment system and the leachate monitoring needs to ensure proper operation of the treatment facility and compliance with the NPDES Permit.

All leachate, collected through the LCS and LDS drainage layers, is currently routed to Phase II of the AWWT facility for treatment. Phase II was constructed to treat a variety of sitewide process water, storm water, and remediation wastewater generated during the Fernald site's remedial actions. AWWT Phase II includes treatment processes for a broad spectrum of contaminants and includes alum coagulant, clarification, filtration, carbon adsorption, and ion exchange.

Leachate is collected from both the LCS and LDS layers of each cell of the OSDF, whenever such fluids are present. The leachate flows by gravity from each cell to their respective valve house, and from their drains through the EPLTS to the control valve house into the permanent lift station. From the permanent lift station, leachate is currently pumped into the Bio-Surge Lagoon, which is the primary collection point for remedial wastewater to be delivered to the AWWT Phase II facility.

The soil remediation of the Bio-Surge Lagoon (slated to begin in November 2004) will require that the leachate flows be directed to the SWRB for subsequent treatment at AWWT Phase I or Phase II. When the conversion of the AWWT expansion facility to the new CAWWT facility is completed in February 2005, leachate collected in the SWRB (including other storm water flows) will be directed to the CAWWT facility. The discharge of leachate to the CAWWT via the SWRB will continue until the SWRB is removed from service in October 2005 to support soil remediation of the area encompassing the SWRB. The CAWWT facility is a planned 1,800-gpm facility divided into a 1,200-gpm treatment train dedicated to groundwater, and a 600-gpm treatment train used for the treatment of storm water and remediation wastewater including leachate. The CAWWT 600-gpm treatment train will contain the same unit operations as the current AWWT Phase II system with the exception of clarification/sedimentation. All discharges from the current AWWT facility and the future CAWWT will be through the NPDES Outfall PF 4001. Note that a passive treatment system for OSDF leachate is being evaluated for potential use at the Fernald site post-closure.

5.2 CONFIRMATION OF LEAK DETECTION INDICATOR PARAMETERS

The final leachate management monitoring requirement entails the annual confirmation of the site-specific leak detection indicator parameters. The purpose of this annual sampling is to confirm the appropriateness of the site-specific leak detection indicator parameters in the event that leachate composition changes over time, as described in OAC 3745-27-10(D)(2). An annual leachate grab sample is obtained and analyzed for parameters listed in Ohio Solid Waste regulation OAC 3745-27-10 and 19 (i.e., Appendix I and PCBs). This sampling is necessary to fulfill the reporting requirement in OAC 3745-27-19(M)(5), which requires reporting the data from an annual grab sample of leachate.

While it is anticipated that the results from analysis of the annual grab of leachate may indicate the presence of parameters not included in the leak detection indicator parameter list, it is not anticipated that these other parameters will exist in the leachate at concentrations high enough to warrant their addition to the leak detection indicator parameter list. However a review of the data will be conducted (and reported through the annual site environmental reports) to determine if any new indicator constituents should be added to the site-specific leak detection indicator parameter list. A constituent will be added if: (1) concentrations observed in the annual sample are much higher than the perched water concentrations at the Fernald site; and (2) routine analysis of the constituent can significantly enhance early detection capability. The leak detection leachate analysis will ensure that the character of the leachate will not adversely impact the treatment facility or the treatment facility effluent receiving stream (the Great Miami River).

In order to gain pre-waste placement information, a sample from both the LCS and LDS is collected and analyzed for the annual leachate monitoring parameter list. This is not a regulatory requirement, but was added to the monitoring requirements in order to obtain baseline information. This requirement was initiated in 2002.

A subsequent future re-evaluation of the program (e.g., a review of monitoring results accompanying final capping) is envisioned before the long-term, post-closure leak detection monitoring parameters list is ultimately finalized. As previously mentioned, all additions and deletions to the indicator list will be identified to EPA and OEPA and approved prior to implementation.

5.3 FUTURE CONSIDERATIONS

The frequency for sampling leachate for parameters necessary to determine proper management within the site treatment facility may need to be modified over time. Section 6.0 provides further information concerning the process for altering any of the components of this plan.

6.0 REPORTING

6.1 ROUTINE REPORTING RESPONSIBILITIES

As indicated in Section 4.5, after the baseline sampling events are completed, DOE will evaluate whether sufficient data are available to ascertain the type of distribution of the data, and from that, select an appropriate statistical method and associated statistical measure. This determination is anticipated to be made based on parameters, monitoring points, systems (i.e., glacial till and Great Miami Aquifer), and cells. Also, once sufficient samples are in hand to establish a baseline for a sampling point, the leak detection program sampling frequency for that point will be reduced to quarterly during active cell operations. These cell-specific evaluations are and will be summarized in cell-specific technical memoranda, which will be submitted to EPA and OEPA for review. The technical memoranda will serve as the mechanism to propose modifications to this initial groundwater/leak detection and leachate monitoring plan in areas such as, but not limited, to the following:

- Modification of leak detection monitoring parameters list for routine monitoring based on considerations presented in Section 4.4
- Modification of sampling frequency for LCS, LDS, glacial till, or Great Miami Aquifer monitoring points, based on considerations presented in Section 4.5
- Modification of leachate management monitoring parameters based on considerations presented in Section 5.2
- Establishment of a parameters list for statistical analysis
- Establishment of frequency for statistical analysis
- Establishment of an appropriate statistical method and associated statistical measurements
- Establishment of an action leakage rate for the LDS
- Establishment of a pump operating level for the LCS
- Temporary suspension or cessation of sampling and attendant statistical analysis for monitoring points (either singly or in combination)
- Modifications to address future needs resulting from the completion of aquifer restoration and/or the entry of the OSDF into the post-closure care mode.

Where appropriate, the approved the technical memoranda will be attached as addenda to this plan, formally resulting in an amended groundwater/leak detection and leachate monitoring plan.

To provide an integrated approach to reporting OSDF monitoring data, LCS and LDS flow data and concentrations, along with groundwater monitoring results, trending results, and interpretation of the data will be provided in the annual site environmental reports. Presenting data in one report will facilitate a qualitative assessment of the impact of the OSDF on the aquifer, as well as the operational characteristics of OSDF caps and liners. Additionally, the available monitoring data and interpretation of that data will be made available in other IEMP data summaries (e.g., the IEMP mid-year data summaries).

6.2 NOTIFICATIONS AND RESPONSE ACTIONS

If the flow rate into the LDS exceeds the action leakage rate (see Section 4.5.2.1) for any LDS sump, the actions presented in Table 6-1 will be implemented. Note that some of these response actions (i.e., those that do not pose an immediate and substantial threat to human health or the environment) might best be served by a corrective action (see Section 9.0 of the OSDF Post-Closure Care and Inspection Plan).

If it is determined that both the cap and primary liner have failed, then an OSDF response action will be required. A response action might include initiating cap repair, investigating whether or not contamination has breached the compacted clay liner component of the secondary composite liner system that lies beneath the LDS, increasing monitoring, or a combination of these. Potential leakage through the clay liner will be assessed by using the horizontal till well installed beneath the liner penetration box area and secondary liner; however, till well monitoring cannot be considered all-conclusive for detecting a leak. Comparison of the data from all four systems is needed to determine if a leak has occurred. If it is determined that a leak has adversely impacted the groundwater (till and/or Great Miami Aquifer), then a groundwater quality assessment monitoring program will be developed and initiated to determine the nature, rate, and extent of contaminant migration. Groundwater monitoring might also be increased to determine if leakage from the OSDF has entered the Great Miami Aquifer, although given the distances involved it would be unlikely that leakage from the OSDF would be able to migrate to the Great Miami Aquifer in the short time frame between leak detection and response.

TABLE 6-1

NOTIFICATION AND RESPONSE ACTIONS

Step	Timeframe	Action
1	Within 7 days of the determination of the exceedance.	Notify both the following in writing: ☐ EPA Region 5 Regional Administrator 77 West Jackson Boulevard Chicago, Illinois 60604-3590 ☐ Ohio Director of Environmental Protection 1800 Watermark Drive P.O. Box 1049 Columbus, Ohio 43266-0149
2	Within 14 days of the determination of the exceedance.	Submit to both of the individuals identified in Step 1 a written preliminary assessment as to the: ☐ Amount of liquids. ☐ Likely sources of liquids. ☐ Possible location, size, and cause of any leaks. ☐ Short-term actions taken and planned.
3	As practicable to meet Step 7.	Determine to the extent practicable the location, size and cause of any leak.
4	As practicable to meet Step 7.	Determine: ☐ Whether receipt of impacted materials should be ceased or curtailed. ☐ Whether any impacted materials within the OSDF or any individual cell/phase should be removed for inspection, repairs, or controls.
5	As practicable to meet Step 7.	Determine any other short- or long-term actions to take to stop or mitigate the leaks.
6	As practicable to meet Step 7.	In order to conduct Steps 3-5: ☐ Assess the source of liquids, and amounts of liquids by source; and ☐ In order to identify the source of liquids and the possible location of any leaks, and the hazard and mobility of the liquid, conduct a fingerprint, hazardous constituent, or other analyses of the liquids in the LDS; and ☐ Assess the seriousness of any leaks in terms of potential for escaping into the environment. OR ☐ Document why such assessments are not needed.
7	Within 30 days of the notification given in Step 1.	Submit to both of the individuals identified in Step 1 a written report of the: ☐ Results of the analyses & determinations made under Steps 3-6 (to the extent completed). ☐ Results of action taken. ☐ Actions ongoing (i.e., analyses and determinations under Steps 3-6 not yet completed) or planned (see Section 9.0 of the OSDF Post-Closure Care and Inspection Plan).
8	Monthly thereafter, as long as the flow rate in the LDS exceeds the action leakage rate.	Submit to both of the individuals identified in Step 1 a written report summarizing the: ☐ Results of actions taken. ☐ Actions planned.

SOURCE: Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart NCLandfills, Response Actions, 40 CFR 264.304(b) and 265.303(b).

7.0 REFERENCES

Fenneman, Nevin M., *Geology of Cincinnati and Vicinity,* Geological Survey of Ohio, Bulletin 19, Columbus, OH, 1916.

GeoSyntec Consultants, *Borrow Area Management and Restoration Plan; On-Site Disposal Facility*, Revision 1, 20100-PL-0003, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, August 2001a.

GeoSyntec Consultants, *Construction Quality Assurance Plan; On-Site Disposal Facility*, Revision 1, 20100-PL-0006, Fernald Environmental Management Project, DOE Area Office, Fernald, OH, May 2001b.

GeoSyntec Consultants, *Final Design Calculation Package; On-Site Disposal Facility*, Volume I, Revision 0, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, May 1997.

GeoSyntec Consultants, *Final Design Package; On-Site Disposal Facility*, Atlanta, GA, 1996a.

GeoSyntec Consultants, *Impacted Materials Placement Plan; On-Site Disposal Facility*, Revision 3, PCN 2, 20100-PL-007, Fernald Closure Project, DOE Fernald Area Office, Fernald, OH, March 2004.

GeoSyntec Consultants, *Intermediate Design Package; On-Site Disposal Facility*, Atlanta, GA, 1996b.

GeoSyntec Consultants, *Surface Water Management and Erosion Control Plan; On-Site Disposal Facility*, Revision 1, 20100-PL-004, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, August 2001c.

U.S. Department of Energy (DOE), *Comprehensive Legacy Management and Institutional Control Plan*, Fernald Closure Project, DOE Fernald Area Office, Fernald, OH, July 2004a.

U.S. Department of Energy (DOE), *Feasibility Study Report for Operable Unit 5*, Fernald Environmental Management Project, DOE Fernald Field Office, Fernald, OH, June 1995a.

U.S. Department of Energy (DOE), *Great Miami Aquifer VAM3D Flow Model Re-Calibration*, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, May 2000.

U.S. Department of Energy (DOE), *Groundwater/Leak Detection and Leachate Monitoring Plan; On-Site Disposal Facility*, Revision 0, Final, 201000-PL-009, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald OH, August 1997.

U.S. Department of Energy (DOE), *Integrated Environmental Monitoring Plan*, Revision 3, Final, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, 2003a.

U.S. Department of Energy (DOE), *Post-Closure Care and Inspection Plan; On-Site Disposal Facility*, Revision 2, 20100-PL-010, Fernald Closure Project, DOE Fernald Area Office, Fernald, OH, July 2004b.

U.S. Department of Energy (DOE), *Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility*, Fernald Environmental Management Project, DOE Fernald Field Office, Fernald, OH, July 1995b.

U.S. Department of Energy (DOE), *Project-Specific Plan for Installation of the On-Site Disposal Facility Great Miami Aquifer Monitoring Wells*, Revision 3, Final, 20100-PSP-0002, Fluor Fernald, Inc., DOE Fernald Area Office, Fernald, OH, August 2001a.

U.S. Department of Energy (DOE), *Remedial Action Work Plan for the On-Site Disposal Facility*, Fernald Environmental Management Project, DOE Fernald Field Office, Fernald, OH, 1996.

U.S. Department of Energy (DOE), *Remedial Investigation Report for Operable Unit 5*, Fernald Environmental Management Project, DOE Fernald Field Office, Fernald, OH, March 1995c.

U.S. Department of Energy (DOE), *Sitewide CERCLA Quality Assurance Project Plan*, Revision 3, FD-1000, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, November 2003b.

U.S. Department of Energy (DOE), *Systems Plan; Collection and Management of Leachate for the On-Site Disposal Facility*, Revision 0, 20111-PL-0001, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, January 2001b.

U.S. Department of Energy (DOE), *Technical Memorandum for the On-Site Disposal Facility Cells 1, 2, and 3 Baseline Groundwater Conditions*, Final, 20100-RP-0021, Fernald Environmental Management Project, DOE Fernald Area Office, 2002.

APPENDIX A

OSDF ARARs AND OTHER REGULATORY REQUIREMENTS

APPENDIX A

OSDF ARARS AND OTHER REGULATORY REQUIREMENTS

ARARs and to be considered criteria (TBCs) — for OSDF groundwater detection monitoring, OSDF leachate monitoring, and OSDF response action — that should be addressed by this plan are provided here, as obtained from the *Final Record of Decision for Remedial Actions at Operable Unit 2 (OU2 ROD)* [DOE, 1995b], the *Record of Decision for Final Remedial Action at Operable Unit 3 (OU3 ROD)* [DOE, 1996d], the *Final Record of Decision for Remedial Actions at Operable Unit 5 (OU5 ROD)* [DOE, 1996b], or the *Permitting Plan and Substantive Requirements for the On-Site Disposal Facility* [DOE, 1996c]. Additional regulatory requirements that are appropriate guidance for formulation of this plan have been also identified and included.

TABLE A-1

OSDF GROUNDWATER/LEAK DETECTION AND LEACHATE MONITORING PLAN COMPLIANCE STRATEGY ARARs AND OTHER REGULATORY REQUIREMENTS

Citation	Requirement
PLANS	
Ohio Municipal Solid Waste Rules-Sanitary Landfill Facility Permit to Install Application OAC 3745-27-06(C)(9)(a)	• Prepare a "groundwater detection monitoring plan" as required by OAC 3745-27-10, and if applicable a "groundwater quality assessment plan" and/or "corrective measures plan" required by OAC 3745-27-10.
	• Prepare a "leachate monitoring plan" to ensure compliance with OAC 3745-27-19(M)(4) and (5).
GROUNDWATER/LEAK DETECTION MONITORING	
Ohio Municipal Solid Waste Rules-Groundwater Monitoring Program for a Sanitary Landfill Facility OAC 3745-27-10(A)	(1) The owner or operator of a sanitary landfill facility shall implement a "groundwater monitoring program" capable of determining the quality of groundwater occurring within the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system underlying the landfill facility, with the following elements: (a) A "groundwater detection monitoring program" which includes: (i) a "groundwater detection monitoring plan" in accordance with OAC 3745-27-10(B) through (D); (ii) a monitoring system in accordance with OAC 3745-27-10(B); (iii) sampling and analysis procedures, including an appropriate statistical method, in accordance with OAC 3745-27-10(C); and (iv) detection monitoring procedures, including monitoring frequency and a parameter list, in accordance with OAC 3745-27-10(D). (2) Schedule for implementation of detection monitoring. (4) For purposes of this rule, the groundwater monitoring program is implemented upon commencement of sampling of groundwater wells.
Ohio Municipal Solid Waste Rules-Ground Water Monitoring System OAC 3745-27-10(B)	(1) The "groundwater detection monitoring program" shall consist of sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from both the uppermost aquifer system and any significant zones of saturation that exist above the uppermost aquifer system that: (a) represent the quality of the background groundwater that has not been affected by past or present operations; and (b) represent the quality of the groundwater passing directly downgradient of the limits of solid waste placement. (4) The number, spacing, and depth of groundwater monitoring wells shall be: (a) based on site specific hydrogeologic information; and (b) capable of detecting a release from the facility to the groundwater at the closest practicable location to the limits of waste placement.
Ohio Municipal Solid Waste Rules- Ground Water Sampling, Analysis, and Statistical Methods OAC 3745-27-10(C)	(1) The "groundwater monitoring program" shall include consistent sampling and analysis procedures and statistical methods that are protective of human health and the environment and that are designed to ensure monitoring results that provide an accurate presentation of groundwater quality at the background and downgradient well. (a) Sampling and analysis procedures employed must be documented in a written plan. (b) The statistical method selected by the owner or operator must be in accordance with OAC 3745-27-10(C)(6)&(7). (6) After completing collection of the background data, the owner or operator shall specify one of the following statistical methods to be used in evaluating groundwater quality; the statistical method chosen must be conducted separately for each of the parameters required to be statistically evaluated: (a) a parametric analysis of variance (ANOVA); or (b) an analysis of variance (ANOVA) based on ranks; or (c) a tolerance or prediction interval procedure; or (d) a control chart approach; or (e) another statistical method.

TABLE A-1
(Continued)

Citation	Requirement
	GROUNDWATER/LEAK DETECTION MONITORING (Cont'd.)
	(7) Performance standards for statistical methods. (a) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of chemical parameters or leachate and leachate-derived constituents. If shown to be inappropriate, then the data should be transformed or a distribution free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed. (e) The statistical method shall account for data below the limit of detection with one or more statistical procedures that ensure protection of human health and the environment. Any practical quantitation limit (PQL) used in the statistical method shall be the lowest concentration level that can be reliably achieved within the specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility. (f) If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temperal correlation in the data. (9) The number of samples collected to establish groundwater quality data shall be consistent with the appropriate statistical procedures.
Ohio Municipal Solid Waste Rules-Ground Water Detection Monitoring Program OAC 3745-27-10(D)	(2) Alternate monitoring parameter list. The owner or operator of a sanitary landfill facility may propose to delete any of the Appendix I parameters of this rule. The alternative monitoring parameter list may be approved if the removed parameters are not reasonably expected to be in or derived from the waste contained or deposited in the landfill facility. The following factors should be considered: (a) which of the parameters in Appendix I shall be deleted; (b) types, quantities, and concentrations of constituents in wastes managed at the landfill facility; (c) the concentrations of Appendix I constituents in the leachate from the relevant unit(s) of the landfill facility; (d) any other relevant information. (3) Alternate inorganic parameter list. The owner or operator of a sanitary landfill facility may propose that an alternative list of inorganic indicator parameters to be used in lieu of some or all of the inorganic parameters listed in Appendix I of this rule. The alternative inorganic indicator parameters may be approved if the alternative list will provide a reliable indication of inorganic releases from the facility to the groundwater. The following factors should be considered: (a) the types, quantities, and concentrations of constituents in wastes managed at the facility; (b) the mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the facility; (c) the detectability of the indicator parameters, waste constituents, and their reaction products in the ground water; and (d) the concentrations or values and coefficients of variation of monitoring parameters or constituents in the background groundwater quality. (5) Monitoring parameters, frequency, location. The owner or operator shall monitor the groundwater monitoring well system (a) and (b)during the active life of the facility (including final closure and the post-closure care period, (ii) at least semiannually by collecting: (*a*) during the initial one hundred and eighty days after implementing the groundwater detection monitoring program (the first semiannual sampling event), a minimum of four independent samples from each monitoring well. Collect and analyze a minimum of eight independent samples during the first year of sampling. (*b*) After the first year during subsequent semiannual sampling events, at least one sample for each monitoring well. (iii) beginning with receiving the results from the first monitoring event under (D)(5)(a)(ii)(b) of this rule and semiannually thereafter, by statistically analyzing the results. (6) Alternative sampling and statistical analysis frequency. The owner or operator of a sanitary landfill facility may propose an alternative frequency for groundwater sampling and/or statistical analysis. The alternative frequency may be approved provided it is not less than annual. The following factors should be considered: (a) lithology of the aquifer system and all stratigraphic units above the uppermost aquifer system; (b) hydraulic conductivity of the uppermost aquifer system and all stratigraphic units above the uppermost aquifer system; (c) groundwater flow rates for the uppermost aquifer system and all zones of saturation above the uppermost aquifer system; (d) minimum distance between the upgradient edge of the limits of waste placement of the landfill facility and the downgradient monitoring well system; and (e) resource value of the uppermost aquifer system. NOTE: Table B-3 of the OU5 ROD @ p. B.3-25 states "an alternate list of monitoring parameters will be required."

TABLE A-1
(Continued)

Citation	Requirement
	GROUNDWATER/LEAK DETECTION MONITORING (Cont'd.)
Ohio Hazardous Waste General Facility Standards-New Facilities Rules-Required Programs OAC 3745-54-91; 40 CFR 264.91	Owners or operators subject to the groundwater protection rules must conduct a monitoring and response program as follows: (1) whenever hazardous constituents from a regulated unit are detected at the compliance point, the owner or operator must institute a compliance monitoring program. "Detected" is defined as statistically significant evidence of contamination. (2) whenever the groundwater protection standard is exceeded, the owner or operator must institute a corrective action program. "Exceeded" is defined as statistically significant evidence of increased contamination. (3) whenever hazardous constituents from a regulated unit exceed concentration limits in groundwater between the compliance point and the downgradient facility property boundary, the owner or operator must institute a corrective action program. (4) in all other cases, the owner or operator must institute a detection monitoring program.
Ohio Hazardous Waste General Facility Standards-New Facilities Rules-Groundwater Protection Standard OAC 3745-54-92; 40 CFR 264.92	The owner or operator must comply with conditions specified in the facility permit that are designed to ensure that hazardous constituents detected in the groundwater from a regulated unit do not exceed the specified concentration limits (specified in the permit) in the uppermost aquifer underlying the waste management area beyond the point of compliance. The groundwater protection standard will be established when hazardous constituents have been detected in the groundwater.
Ohio Hazardous Waste General Facility Standards-New Facilities Rules-Hazardous Constituents OAC 3745-54-93; 40 CFR 264.93	(A) The permit will specify the hazardous constituents to which the groundwater protection standard applies. Hazardous constituents are those that have been detected in the groundwater in the uppermost aquifer underlying a regulated unit and that are reasonably expected to be in or derived from waste contained in a regulated unit, unless excluded under paragraph B of this rule. (B) A constituent will be excluded from the list of hazardous constituents specified in the facility permit if it is found that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment. The following will be considered: (1) Potential adverse effects on groundwater quality, considering: (a) the physical and chemical characteristics of the waste in the regulated unit, included its potential for migration; (b) the hydrogeological characteristics of the facility and surrounding land; (c) the quantity of groundwater and the direction of groundwater flow; (d) the proximity and withdrawal rates of groundwater users; (e) the current and future use of groundwater in the area; (f) the existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater quality; (g) the potential for health risks caused by human exposure to waste constituents; (h) the potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; (i) the persistence and permanence of the potential adverse effects.
Ohio Hazardous Waste General Facility Standards-New Facilities Rules-General Groundwater Monitoring Requirements OAC 3745-54-97; 40 CFR 264.97	(G) In detection monitoring or where appropriate in compliance monitoring, data on each constituent specified in the permit [or in the monitoring plan] is to be collected from background wells and wells at compliance point(s). The number and kinds of samples collected to establish background shall be appropriate for the form of statistical test employed. The sample size should be as large as necessary to ensure with reasonable confidence that a contaminant release to the groundwater from a facility will be detected. The owner or operator will determine an appropriate sampling procedure and interval for each constituent. (H) The owner or operator is to specify one of the following statistical methods to be used in evaluating groundwater monitoring data for each constituent to be specified ... Use of any of the following statistical methods must be protective of human health and the environment: (1) a parametric analysis of variance (ANOVA); (2) an analysis of variance (ANOVA) based on ranks; (3) a tolerance or prediction interval procedure; (4) a control chart approach; or (5) another statistical method.

TABLE A-1
(Continued)

Citation	Requirement
	GROUNDWATER/LEAK DETECTION MONITORING (Cont'd.)
Ohio Hazardous Waste General Facility Standards-New Facilities Rules-Detection Monitoring Program OAC 3745-54-98; 40 CFR 264.98	(A) The owner or operator must monitor for indicator parameters (e.g., specific conductance, total organic carbon, or total organic halogen), waste constituents, or reaction products that provide a reliable indication of the presence of hazardous constituents in groundwater. The director [of OEPA] will specify the parameters or constituents to be monitored in the facility permit, after considering the following factors: (1) types, quantities, and concentrations of constituents to be managed at the regulated unit; (2) mobility, stability, and persistence of the waste constituents or their reaction products in the unsaturated zone beneath the waste management area; (3) detectability of the indicator parameters, waste constituents, and their reaction products in the ground water; and (4) concentrations or values and coefficients of variation of proposed monitoring parameters or constituents in the ground water background. (D) The permit will specify the frequencies for collecting samples and conducting statistical tests to determine whether there is statistically significant evidence of contamination for any parameter or hazardous constituent specified in the permit. (F) The owner or operator must determine whether there is statistically significant evidence of contamination for any chemical parameter or hazardous constituent specified in the permit at the frequency specified in the permit.
Federal Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings: Subpart D-Standards for Management of Uranium Byproduct Material Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended 40 CFR 192.30 through .34	Uranium byproduct materials shall be managed to conform to the ground water protection standard in 40 CFR 264.92, which includes detection monitoring. Alternate concentration limits for uranium can be established, as described in 40 CFR 264.95 and 264.94(b).
Environmental Monitoring DOE M 435.1-1	I.1.E.(7) Environmental Monitoring. Radioactive waste management facilities, operations, and activities shall meet the environmental monitoring requirements of DOE 5400.1, *General Environmental Protection Program;* and DOE 5400.5, *Radiation Protection of the Public and the Environment.* IV.R.(3)(a) The site-specific performance assessment and composite analysis shall be used to determine the media, locations, radionuclides, and other substances to be monitored. IV.R.(3) Disposal Facilities. (C) The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives in this Chapter.
	LEACHATE MANAGEMENT & MONITORING
Ohio Municipal Solid Waste Rules-Operational Criteria for a Sanitary Landfill Facility OAC 3745-27-19(M)(4)&(5)	The owner annually shall report: • a summary of the quantity of leachate collected for treatment and disposal on a monthly basis during the year; location of leachate treatment and/or disposal; and verification that the leachate management system is operating in accordance with this rule; • results of analytical testing of an annual grab sample of leachate.
	OTHER REQUIREMENTS
Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart N-Landfills, Monitoring and Inspection 40 CFR 264.302	Action Leakage Rate: (a) The action leakage rate is the maximum design flow rate that the leak detection system (LDS) can remove without the fluid head on the bottom liner exceeding 1 foot. The action leakage rate must include an adequate safety margin to allow for uncertainties in the design (e.g., slope, hydraulic conductivity, thickness of drainage material), construction, operation, and location of the LDS, waste and leachate characteristics, likelihood and amounts of other sources of liquids in the LDS, and proposed response actions (e.g., the action leakage rate must consider decreases in the flow capacity of the system over time resulting from siltation and clogging, rib layover and creep of synthetic components of the system overburden pressures, etc.). (b) To determine if the action leakage rate has been exceeded, the owner or operator must convert the weekly or monthly flow rate from the monitoring data obtained under 40 CFR 264.303(c), to an average daily flow rate (gallons per acre per day) for each sump (i.e., liner penetration box). Unless the [EPA] approves a different calculation, the average daily flow rate for each sump must be calculated weekly during the active life and closure period, and monthly during the post-closure care period when monthly monitoring is required under 40 CFR 264.303(c).

OTHER REQUIREMENTS (Cont'd.)

TABLE A-1
(Continued)

Citation	Requirement
Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart N-Landfills, Monitoring and Inspection 40 CFR 264.303(c)	An owner or operator required to have a leak detection system must record the amount of liquids removed from each leak detection system sump as follows: (1) During the active life and closure period, at least once each week. (2) After the final cover is installed, in accordance with the following graded approach- • at least monthly; or • if the liquid level in the sump stays below the pump operating level for two consecutive months, at least quarterly; or • if the liquid level in the sump stays below the pump operating level for two consecutive quarters, at least semiannually; but • if at any time during the post-closure care period the pump operating level is exceeded at units on quarterly or semiannual recording schedules, the owner or operator must return to monthly recording of amounts of liquids removed from each sump until the liquid level again stays below the pump operating level for two consecutive months. NOTE: There are no requirements in Ohio hazardous waste or Ohio solid waste rules regarding leak detection system flow monitoring.
Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart N-Landfills, Response Actions 40 CFR 264.304	(a) The owner or operator of landfill units subject to 264.301(c) or (d) must have an approved response action plan before receipt of waste. The response action plan must set forth the action to be taken if the "action leakage rate" has been exceeded [in any leak detection system sump]. (b) At a minimum, the response action plan [see entry 2 above] must describe the following actions to be taken: (1) Notify the Regional Administrator in writing of the exceedance within 7 days of the determination; (2) Submit a preliminary written assessment to the Regional Administrator within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, and cause of any leaks, and short-term actions taken and planned; (3) Determine to the extent practicable the location, size, and cause of any leak; (4) Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether or not the unit should be closed; (5) Determine any other short-term or longer-term actions to be taken to mitigate or stop any leaks; and (6) Within 30 days of the notification that the action leakage rate has been exceeded, submit to the Regional Administrator the results of the analysis specified in (3), (4) and (5) [above], the results of action taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the action leakage rate, the owner or operator must submit to the Regional Administrator a report summarizing the results of any remedial actions taken and actions planned. (c) To make the leak and/or remedial action determinations in paragraphs (b)(3), (4) and (5) [above], the owner or operator must: • Asses the source of liquids, and amount of liquids by source; • Conduct a fingerprint, hazardous constituent, or other analyses of the liquids in the leak detection system to identify the source of liquids and possible location of any leaks, and the hazard and mobility of the liquid; and • Assess the seriousness of any leaks in terms of potential for escape to the environment; or • Document why such assessments are not needed.

APPENDIX B

PROJECT-SPECIFIC PLAN
FOR THE ON-SITE DISPOSAL FACILITY MONITORING PROGRAM

PROJECT-SPECIFIC PLAN FOR THE ON-SITE DISPOSAL FACILITY MONITORING PROGRAM

Project Number 20100-PSP-0001
Revision 7

June 2004

Prepared by
Fluor Fernald

Prepared for
Fernald Closure Project

PROJECT-SPECIFIC PLAN FOR THE ON-SITE DISPOSAL FACILITY MONITORING PROGRAM

PROJECT NUMBER 20100-PSP-0001
REVISION 7

JUNE 2004

APPROVALS:

William G. Hertel — 6-23-04

William Hertel, Hydrogeology — Date

Darren Wessel for Reinhard Friske — 6-23-04

Reinhard Friske, Quality Assurance — Date

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ASL	Analytical Support Level
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
DQO	data quality objective
GMA	Great Miami Aquifer
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HTW	horizontal till well
IEMP	Integrated Environmental Monitoring Plan
L	liter
LCS	leachate collection system
LDS	leak detection system
mL	milliliter
NTUs	nephelometric turbidity units
OSDF	On-Site Disposal Facility
PSP	Project-Specific Plan
QC	Quality Control
SCQ	Sitewide CERCLA Quality Assurance Project (SCQ).
SED	Sitewide Environmental Database
TOC	total organic carbon
TOX	total organic halogens
V/FCN	Variance/Field Change Notice

1.0 INTRODUCTION

1.1 PURPOSE

This project-specific plan (PSP) was developed in support of the Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP) for the On-Site Disposal Facility (OSDF). The GWLMP divides the OSDF monitoring program into two primary elements: (1) a leak detection component, which will provide information to verify the ongoing performance and integrity of the OSDF, and its impact on groundwater; and (2) a leachate monitoring component, which will satisfy requirements for leachate collection and management. This PSP discusses requirements for sampling groundwater monitoring system, leachate collection system (LCS), and leak detection system (LDS) for both baseline and post-baseline phases. All sampling and analysis activities will be consistent with the data quality objective (DQO) GW-024, Revision 6 (FCP 2004).

1.2 SCOPE

The construction of the OSDF is being completed in phases with eight individual cells (see Figure 1-1) and a ninth contingency cell planned. Each individual cell will be constructed with a LCS to collect infiltrating rainwater and a LDS to provide early detection of leakage from the individual cells. Additionally, groundwater within the glacial till will be monitored using a series of horizontal till wells constructed beneath each cell and the Great Miami Aquifer (GMA) will be monitored by conventional monitoring wells located upgradient and downgradient of each OSDF cell.

The monitoring strategy, as outlined in the GWLMP, recognizes the various operating phases of the OSDF including periods before, during, and after waste placement. This PSP addresses sample requirements for establishment of baseline conditions and post-baseline (i.e., during active cell operations and after cells are capped) monitoring requirements.

1.3 KEY PROJECT PERSONNEL

The key project personnel for this project are listed in Table 1-1:

TABLE 1-1

KEY PROJECT PERSONNEL

Title	Primary	Alternate
Project Manager	Bill Hertel	Karen Voisard
Field Sampling Lead	Karen Voisard	Dan Foster
Laboratory Contact	Chuck White	Heather Medley
Data Management Lead	Cindy Tabor	Chuck White
Quality Assurance Contact	Reinhard Friske	Darren Wessel
Health and Safety Contact	Gregg Johnson	Jeff Middaugh

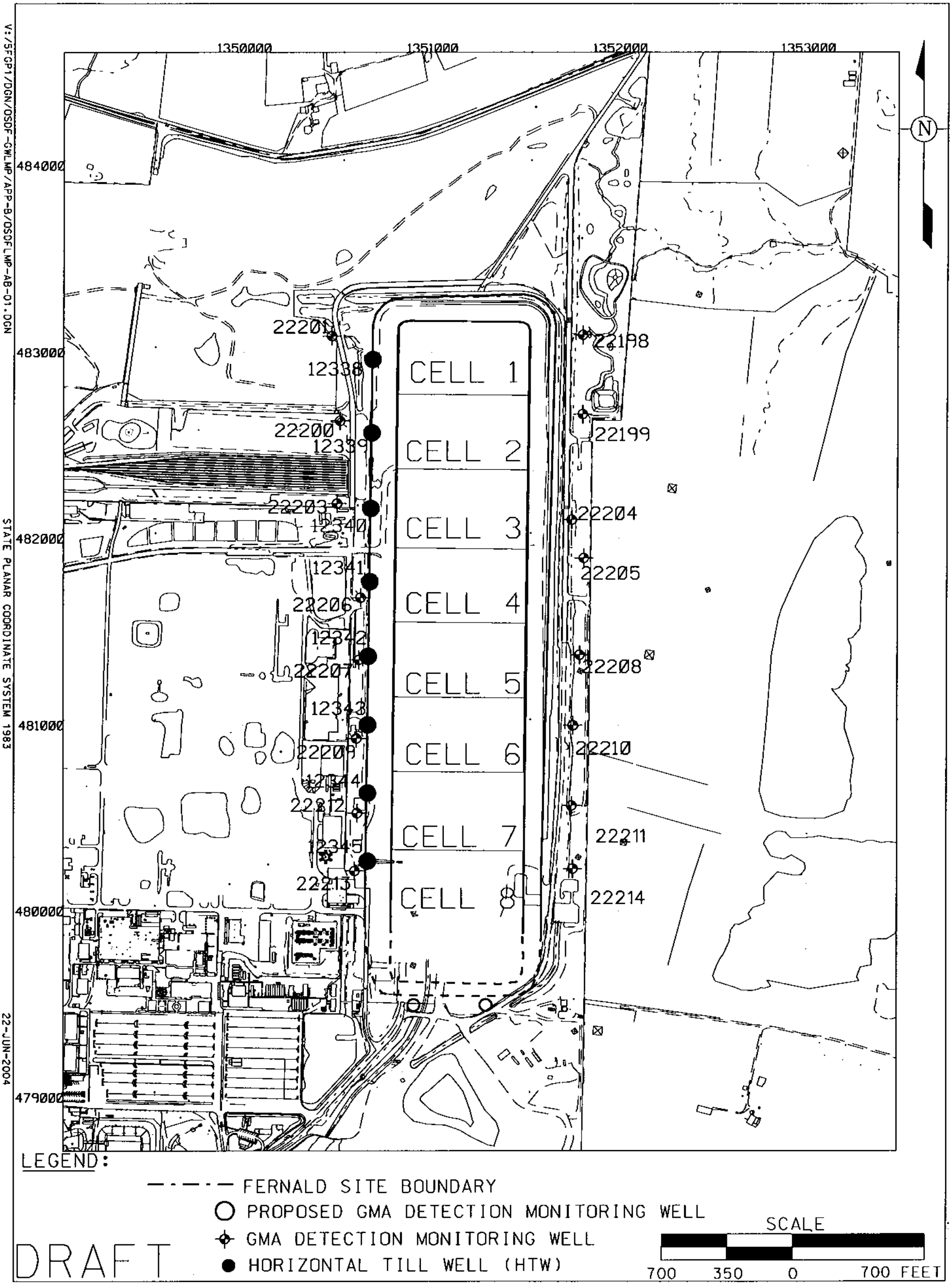


FIGURE 1-1. OSDF WELL LOCATIONS

2.0 SAMPLING PROGRAM

To determine whether there has been a leak from the OSDF, it is necessary to establish representative baseline conditions for all OSDF analytical parameters in the perched groundwater system and the GMA. For each cell, baseline samples will be collected for both the perched system and each of the GMA wells for all of the site-specific parameters listed in Table 2-1. Generally, during the pre-waste placement period, one baseline sampling round per month is planned. After waste placement begins, baseline sampling frequency will be adjusted to one round every other month.

Once the cell-specific baseline sampling is complete, the sampling frequency will be modified to quarterly for the remainder of the active life of each individual cell unless otherwise specified. Preferably, all horizons for a particular cell will be sampled during the same time frame to enhance the comparability of the data.

Specific monitoring requirements for each cell are provided in Sections 2.1 and 2.2. Under the scope of this PSP, Cells 4, 5, 6, 7, and 8 are under baseline monitoring and Cells 1, 2, and 3 are under post-baseline monitoring. Analytical detection limits, at a minimum, will meet the applicable final remediation levels identified in the Integrated Environmental Monitoring Plan (IEMP), Revision 3 (DOE 2003). A summary of sampling requirements for each OSDF cell is presented in Table 2-1.

2.1 SAMPLING AT CELLS 4 THROUGH 8

Sampling will be as follows:

- One sample from the LCS and LDS will be collected immediately prior to placement of waste for the parameters listed in Tables 2-2 and 2-3.
- Quarterly sampling of the LCS and LDS will begin immediately after waste placement and continue during active cell operations for the parameters listed on Table 2-2.
- One sample per year will be collected from each LCS following the start of waste placement in each cell and will be analyzed for the parameters listed on Tables 2-2 and 2-3.
- Monthly samples from the horizontal till well (HTW) and GMA will be collected immediately following well completion. Samples will be analyzed for the parameters listed in Table 2-2. Bi-monthly samples (Table 2-2) will be collected from the HTW and GMA after waste placement begins until there is sufficient data to establish baseline conditions (i.e., 12 sample results at a standardized frequency and at a sufficient data quality).

2.2 SAMPLING AT CELLS 1, 2, AND 3

Monitoring for Cells 1, 2 and 3 will be comprised of the following:

- Annual samples will be collected from the LCS for the parameters listed in Tables 2-2 and 2-3.
- Annual samples will be collected from the LDS for the parameters listed in Table 2-2.
- Quarterly samples will be collected from the LCS, LDS, HTW and GMA for the parameters listed in Table 2-4.

If an analyte is detected in the annual samples from either the LDS or LCS, then confirmatory sampling will be conducted for that constituent for three quarters from the horizon in which it was detected. Depending on the magnitude and persistence of the constituent detected, sampling of the next lower horizon may be considered. The requirements for this confirmatory sampling will be documented and approved through the established variance process.

2.3 ADDITIONAL SAMPLING REQUIREMENTS

In the event insufficient volume is available for collection of the entire analytical suite, the sample sets shall be collected in accordance with the priority listed in Tables 2-2, 2-3, and 2-4. Samples will be collected from the horizontal wells, GMA wells, LCS, and LDS in accordance with the following procedures:

Field Project Prerequisites, ADM-02
Water Sample Shipment, ADM-03
Horiba Water Quality Meter, EQT-02
Liquid Sampling for WM, SMPL-02
Groundwater Level/Total Depth Measurements, SMPL-05
Collection of Field Quality Control Samples, SMPL-21.

2.3.1 LCS and LDS Sample Collection

Samples from the LCS and LDS shall be collected by entering the valve houses located on the western side of each cell. Samples will be collected directly from the sample ports on the bottom of the LCS and LDS as the lines enter the eastern side of the valve house. The LCS is located on the northern side of the valve house and the LDS is located on the southern end of the valve house. No purging of the line is required prior to sample collection. If the discharge line is dry or does not yield enough water for the entire sample suite, the sample will be collected from the LCS and LDS tanks located within the valve house. The samples from the tanks will be collected using a dedicated Teflon bailer.

2.3.2 HTW Sample Collection

The glacial till is monitored under each cell using horizontal wells installed during construction of each cell. Prior to sample collection, the horizontal wells shall be purged of three well volumes or purged to dry, whichever occurs first. Sample collection from the horizontal well shall be accomplished using a Teflon bailer in accordance with *Liquids Sampling for WM*, SMPL-02.

2.3.3 GMA Sample Collection

Each cell is monitored by two GMA wells, located east and west of each individual cell. Two additional GMA wells will be installed on the south side of Cell 8. These wells are sampled using dedicated sampling equipment in accordance with *Liquid Sampling for WM*, SMPL-02.

Beginning in May 2004, the filtering protocol, which is utilized in the IEMP for Great Miami Aquifer samples–where turbidity is greater than 5 nephelometric turbidity units (NTUs)–was implemented as part of this PSP. An objective of the IEMP and the OSDF groundwater monitoring programs is to collect and analyze representative groundwater samples. The sample analysis for metals and radionuclides should quantify species that are dissolved, occur as mobile precipitates, or are adsorbed onto mobile particles. If immobile particles to which metals are bound are allowed to remain in field-acidified samples, then the laboratory analysis will overstate the true concentration of mobile species present in the sample because acidification dissolves precipitates or causes adsorbed metals to desorb. Turbidity readings and the use of filtration to obtain a representative sample are therefore important field concerns for collection of groundwater samples.

Consistent with OEPA guidelines, 5 NTUs will serve as the cut-off for a representative groundwater sample and for determining when filtration of the sample to be analyzed for metals/radionuclides is required. Routine filtration will be avoided at the Fernald site whenever possible. Proper well construction and maintenance will be practiced in order to help keep the turbidity of unfiltered groundwater samples at or below 5 NTUs. If after properly purging a monitoring well, the sample turbidity is greater than 5 NTUs, then the sample will be filtered through a 5-micron filter. If the turbidity of the 5-micron filtered sample is still above 5 NTUs, then the 5-micron filtered sample will be additionally filtered through a 0.45-micron filter. Both the unfiltered and final filtered uranium sample will be analyzed. The final filtered sample will be analyzed for metals and radionuclides only.

TABLE 2-1

SUMMARY OF SAMPLING REQUIREMENTS FOR OSDF

Cell(s)	Monitoring Horizons[a]	Monthly[b] (Pre-Waste Placement)	Bi-Monthly[b] (Waste Placement)	Quarterly[b]	Annually[b]
1, 2, & 3	LCS	NA	NA	Table 2-4	Tables 2-2 & 2-3
	LDS	NA	NA	Table 2-4	Table 2-1
	HTW	Complete	Complete	Table 2-4	NA
	GMA	Complete	Complete	Table 2-4	NA
4 through 8	LCS	NA	NA	Table 2-2	Tables 2-2 & 2-3
	LDS	NA	NA	Table 2-2	NA
	HTW	Table 2-2	Table 2-2	Table 2-2[c]	NA
	GMA	Table 2-2	Table 2-2	Table 2-2[c]	NA

NOTE: One sample will be collected from the Cells 4 through 8 LCS and LDS immediately prior to waste placement for Tables 2-2 and 2-3 constituents.

[a]LCS = leachate collection system
LDS = leak detection system
HTW = horizontal till well
GMA = Great Miami Aquifer
[b]NA = not applicable
[c]Quarterly samples are collected after the baseline period.

TABLE 2-2

BASELINE MONITORING REQUIREMENTS FOR THE LDS, LCS, GLACIAL TILL, AND GREAT MIAMI AQUIFER

Parameter	Method	Priority[a]	ASL[b]	Holding Time	Preservation	Standard Volume	Minimum Volume	Container
Radionuclides:	SCQ[c]		D	6 months	HNO_3 to pH<2			Plastic or Glass
Technetium-99		2				1 L	500 ml	
Uranium, total		1				100 ml	10 ml	
Inorganics:	CLP[d]/SW-846[e]	7	C		HNO_3 to pH<2	1 L	600 ml	Plastic or Glass
Boron				6 months				
Mercury				28 days				
Volatile Organics: Bromodichloromethane, 1,1-Dichloroethene, 1,2-Dichloroethene (total), Tetrachloroethene, Trichloroethene, Vinyl Chloride	CLP[d]/SW-846[e]	3	C	14 days	Cool to 4°C With H_2SO_4, HCL, or solid $NaHSO_4$ to pH<2	5 X 40 ml	1 X 40 ml	Glass vial w/Teflon lined septum cap[f]
Semi-Volatile Organics: Carbazole, 4-Nitroaniline, bis(2-Chloroisopropyl)ether	CLP[d]/SW-846[e]	6	C	7 days to extraction/ 40 days from extraction to analysis	Cool to 4°C	1 L	1L	Amber glass bottle with Teflon-lined cap
Pesticides: Alpha-Chlordane	CLP[d]/SW-846[e]	8	C	7 days to extraction/ 40 days from extraction to analysis	Cool to 4°C	1 L	1 L	Amber glass bottle with Teflon-lined cap
General Chemistry:								
Total Organic Halogens (TOX)	9020B[e]	4	B	28 days	Cool to 4°C, H_2SO_4 to pH<2	500 ml	20 ml	Amber glass w/Teflon-lined cap[g]
Total Organic Carbon (TOC)	9060[e]	5	B	28 days	Cool to 4°C, H_2SO_4 to pH<2	250 ml	125 ml	Amber glass w/Teflon-lined cap
Total Dissolved Solids (TDS)(LCS only)	160.1[h], 2540C[i]	10	B	7 days	None, Cool to 4°C	500 ml	250 ml	Plastic or Glass
Nitrate/Nitrite (LCS only)	353.1[h], 353.2[h], 4500D[i], 4500E[i]	9	B	28 days	Cool to 4°C, H_2SO_4 to pH<2	100 ml	20 ml	Plastic or Glass
Sulfate[j]	375.2[h], 300.0[h], 4500E[i]	11/12	B	28 days	Cool to 4° C	250 ml	100 ml	Plastic

NOTE: In addition, this table is used for the annual monitoring at Cells 1, 2, and 3 for the LDS and LCS (LCS annual monitoring also requires the use of Table 2-3).
NOTE: Field parameters are performed at each sampling location prior to sample collection and include dissolved oxygen, pH, specific conductance, temperature, and turbidity at ASL A, Priority 1.

[a]If sufficient volume is not available for collection of a full suite at standard volume, then the minimum volume is to be collected for all analytical groups. If sufficient volume is still not available for collection of the full suite, then a partial sample is to be collected in accordance with the indicated priority rating.
[b]Analytical Support Level. The ASL may become more conservative, if necessary to meet detection limits or data quality objectives.
[c]Radiological analyses do not have standard methods; however, the performance-based analytical specifications for these parameters are provided in Appendix G of the Sitewide CERCLA Quality Assurance Project (SCQ) (DOE 1992).
[d]EPA Contract Laboratory Program (CLP) Statement of Work, Multi-Media, Multi-Concentration, most recent revision (EPA 2004, EPA 2003). Per the SCQ, where CLP is listed, SW-846 can now be used for ASL C or D.
[e]*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846 (EPA 1998).
[f]No head space.
[g]Minimal head space – as close to zero as possible.
[h]*Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-79-020 (EPA 1983).
[i]*Standard Methods for Analysis of Water and Wastewater*, 17th edition (APHA 1989).
[j]Whenever the parameters from this table are analyzed in conjunction with those in Table 2-2 (e.g., annual LCS sampling round), note that sulfate is also on Table 2-2 and is not required to be collected twice.

TABLE 2-3

ANNUAL SAMPLING AND ANALYSIS REQUIREMENTS FOR THE OSDF LEACHATE COLLECTION SYSTEM[a]

Parameter	Method	Priority[b]	ASL[c]	Holding Time	Preservation	Standard Volume	Minimum Volume	Container
Inorganics:	CLP[d]/SW-846E[e]	7	C	6 months	HNO_3 to pH < 2	1 L	300 ml	Plastic or Glass
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Nickel								
Potassium								
Selenium								
Silver								
Sodium								
Thallium								
Vanadium								
Zinc								
Water Chemistry:								
Ammonia	350.1[f], 350.3[f], 4500C[g], 4500F[g]	13	B	28 days	Cool to 4°C, H_2SO_4 to pH< 2	500 ml	200 ml	Plastic
Chloride	325.2[f], 300(all)[f], 4500B[g]	11	B	28 days	None	250 ml	100 ml	Plastic
Sulfate	375.2[f], 300.0[f], 4500E[g]	12	B	28 days	Cool to 4°C	250 ml	100 ml	Plastic
Total alkalinity	310.1[f], 2320B[g]	14	B	14 days	Cool to 4°C	500 ml	250 ml	Plastic
Volatiles:	CLP[d]/SW-846[e]	3	C	14 days	Cool to 4°, H_2SO_4 to pH < 2	5 X 40 ml	40 ml	Glass/Teflon-lined septum cap[h]
Acetone								
Acrylonitrile								
Benzene								
Bromochloromethane								
Bromoform								
Bromomethane								
2-Butanone								
Carbon disulfide								
Carbon tetrachloride								

TABLE 2-3
(Continued)

Parameter	Method	Priority[b]	ASL[c]	Holding Time	Preservation	Standard Volume	Minimum Volume	Container
Volatiles (Continued):	CLP[d]/SW-846[e]	3	C	14 days	Cool to 4°, H_2SO_4 to pH < 2	5 X 40 ml	40 ml	Glass/Teflon-lined septum cap[h]
Chlorobenzene								
Chloroethane								
Chloroform								
Chloromethane								
Dibromochloromethane								
1,2-Dibromo-3-chloropropane								
Ethylene dibromide[i]								
1,2-Dichlorobenzene								
1,4-Dichlorobenzene								
trans-1,4-Dichloro-2-butene								
1,1-Dichloroethane								
1,2-Dichloroethane								
trans-1,2-Dichloroethene								
1,2-Dichloropropane								
cis-1,3-Dichloropropene								
trans-1,3-dichloropropene								
Ethylbenzene								
2-Hexanone								
Methylene bromide								
Methylene chloride								
Methyl iodide								
4-Methyl-2-pentanone								
Styrene								
1,1,1,2-Tetrachloroethane								
1,1,2,2-Tetrachloroethane								
Toluene								
1,1,1-Trichloroethane								
1,1,2-Trichloroethane								
Trichlorofluormethane								
1,2,3-Trichloropropane								
Vinyl acetate								
Xylenes (Total)								
Polychlorinated Biphenyls Aroclors-1016, 1221, 1232, 1242, 1248, 1254, and 1260	CLP[d]/SW-846[e]	15	C	7 days to extraction/ 40 days from extraction to analysis	Cool to 4°C	2 L	1 L	Amber glass bottle with Teflon-lined cap

NOTE: Field parameters are performed at each sampling location prior to sample collection and include dissolved oxygen, pH, specific conductance, temperature, and turbidity at ASL A.

[a]Annual sampling also includes all constituents listed on Table 2-2.
[b]If sufficient volume is not available for collection of a full suite at standard volume, then the minimum volume is to be collected for all analytical groups. If sufficient volume is still not available for collection of the full suite, then a partial sample is to be collected in accordance with the indicated priority rating.
[c]Analytical Support Level. The ASL may become more conservative, if necessary to meet detection limits or data quality objectives.
[d]EPA Contract Laboratory Program Statement of Work, Multi-Media, Multi-Concentration, most recent revision. Per the SCQ, where CLP is listed, SW-846 can now be used for ASL C or D.
[e]*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846.
[f]*Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-79-020.
[g]*Standard Methods for the Analysis of Water and Wastewater*, 17th edition.
[h]No head space.
[i]Also referred to as 1,2-Dibromoethane.

TABLE 2-4

POST-BASELINE QUARTERLY MONITORING REQUIREMENTS FOR CELLS 1, 2, AND 3

Parameter	Method	Priority[a]	ASL[b]	Holding Time	Preservation	Standard Volume	Minimum Volume	Container
Radionuclides:								
Uranium, total	SCQ[c]	1	D	6 months	HNO_3 to pH<2	100 ml	10 ml	Plastic or Glass
Inorganics:								
Boron	CLP[d]/SW-846[e]	4	C	6 months	HNO_3 to pH<2	1 L	600 ml	Plastic or Glass
General Chemistry:								
Total Organic Halogens (TOX)	9020B[e]	2	B	28 days	Cool to 4°C, H_2SO_4 to pH<2	500 ml	20 ml	Amber glass w/Teflon-lined cap[f]
Total Organic Carbon (TOC)	9060[e]	3	B	28 days	Cool to 4°C, H_2SO_4 to pH<2	250 ml	125 ml	Amber glass w/Teflon-lined cap
Sulfate	375.2[g], 300.0[g], and 4500E[h]	5	B	28 days	Cool to 4°C	250 ml	100 ml	Plastic

NOTE: Field parameters are performed at each sampling location prior to sample collection and include dissolved oxygen, pH, specific conductance, temperature, and turbidity at ASL A, Priority 1.

[a]If sufficient volume is not available for collection of a full suite at standard volume, then the minimum volume is to be collected for all analytical groups. If sufficient volume is still not available for collection of the full suite, then a partial sample is to be collected in accordance with the indicated priority rating.

[b]Analytical Support Level. The ASL may become more conservative, if necessary to meet detection limits or data quality objectives.

[c]Radiological analyses do not have standard methods; however, the performance-based analytical specifications for these parameters are provided in Appendix G of the SCQ.

[d]EPA Contract Laboratory Program Statement of Work, Multi-Media, Multi-Concentration, most recent revision. Per the SCQ, where CLP is listed, SW-846 can now be used for ASL C or D.

[e]*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846.

[f]Minimal head space–as close to zero as possible.

[g]*Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-79-020.

[h]*Standard Methods for the Analysis of Water and Wastewater*, 17th edition.

3.0 ADDITIONAL SAMPLING PROGRAM REQUIREMENTS

3.1 QUALITY ASSURANCE REQUIREMENTS

Self-assessment and independent assessments of work processes and operations will be conducted to assure quality of performance. Self-assessments will evaluate sampling procedures and/or paperwork associated with the sampling effort. Independent assessments will be performed by a Quality Assurance representative by conducting surveillances. Surveillances will be performed at least twice per year at any time during the project and will consist of monitoring/observing ongoing project activity and work areas to verify conformance to specified requirements.

3.2 CHANGES TO THE PROJECT-SPECIFIC PLAN

Prior to the implementation of field changes, the Project Manager and Field Sampling Lead shall be informed of the proposed changes. Once the Field Sampling Lead has approved and obtained approval from the Project Manager, Data Management Lead, and Quality Assurance Contact for the field changes to the plan, the field changes may be implemented. Field changes to the plan shall be noted on a Variance/Field Change Notice (V/FCN). The V/FCN shall be approved by the Project Manager, Field Sampling Lead, Data Management Lead, and Quality Assurance Contact prior to implementation of the changes.

3.3 QUALITY CONTROL SAMPLES

Quality Control (QC) sample analyses are required as part of the GWLMP for the OSDF. A minimum of one set of field QC samples is required for each sampling event. A "sampling event" shall be defined as one cycle or round of sample collection from various locations occurring within a short time frame (i.e., several days). Duplicate and rinsate samples will be collected at a rate of one per sampling event or one per 20, whichever is more frequent. Trip blanks will be collected one per day per team when samples are collected for volatile organic analysis. Field blank samples are collected on per day. A rinsate sample will not be required for those locations with dedicated sample collection equipment. One matrix spike/matrix spike duplicate will be analyzed at a frequency of one per sampling event or one per 20, whichever is more frequent. QC samples will be analyzed for the same analytes as the normal samples.

3.4 EQUIPMENT DECONTAMINATION

All non-dedicated sampling equipment shall be decontaminated to Level II per procedure *Liquid Sampling for WM*, SMPL-02, prior to sample collection at each sample location. Sampling equipment shall also be decontaminated to Level II upon completion of sampling activities, unless equipment has been dedicated to the sample location.

3.5 DISPOSITION OF WASTES

During sampling activities, waste will be generated in various forms; disposition of all waste will be in accordance with site requirements and procedures. The various forms of waste expected to be encountered during this program are contact waste, purge water, and decontamination wastewater.

Contact waste will be minimized by limiting contact with the sample media, and by using disposable materials, whenever possible. Contact waste shall be placed into plastic garbage bags and disposed to a dumpster on site, unless radiological concerns require survey of contact waste. If contact waste is determined to be radiologically contaminated, the assigned radiological control technician/engineer shall survey, contain, label, and disposition the waste according to radiological control requirements.

All decontamination wastewater and purge water will be containerized and disposed in accordance with the Wastewater Discharge Request Form. In general, the water shall be transported to the OSDF lift station for treatment.

3.6 DATA MANAGEMENT

Information collected as a part of this monitoring program will be managed according to the guidelines below to ensure availability of documentation for verification and reference and to ensure regulatory compliance.

Field documentation, as required by the designated procedures for this sampling program (i.e., Field Activity Logs, Water Sample Collection Logs, and Chain of Custody Forms), will be carefully maintained in the field. To assure appropriate documentation was completed during field activities and that documentation was correctly completed, required documentation shall be verified by Water Monitoring personnel. Following the internal department review, field documentation shall receive validation by Quality Assurance personnel. One hundred percent of the analytical data shall be validated in accordance to the ASL specified in Tables 2-2, 2-3, and 2-4. Following data entry of the field information into the Sitewide Environmental Database (SED), the hard copy original field documentation packages shall be stored in controlled file storage cabinets, and eventually a long-term archive environment. Per regulatory guidances, these records must be maintained for a minimum of 30 years.

REFERENCES

American Public Health Association (APHA), *Standard Methods for Analysis of Water and Wastewater*, 17th edition, 1989.

Fernald Environmental Management Project (FEMP), *Fernald Environmental Management Project Data Quality Objective; Monitoring Program for the On-Site Disposal Facility*, Revision 6, GW-024, FEMP, June 2004.

Fluor Fernald, Inc., *Collection of Field Quality Control Samples*, Revision 4, SMPL-21, Environmental Monitoring Project Procedure, Fernald Closure Project, September 2002.

Fluor Fernald, Inc, *Field Project Prerequisites*, Revision 5, ADM-02, Environmental Services Procedure, Fernald Closure Project, April 2004.

Fluor Fernald, Inc., *Groundwater Level/Total Depth Measurements*, Revision 4, SMPL-05, Environmental Services Procedure, Fernald Closure Project, January 2004.

Fluor Fernald, Inc., *Horiba Water Quality Meter*, Revision 2, PCN 1, EQT-02, Environmental Monitoring Project Procedure, Fernald Closure Project, August 2001.

Fluor Fernald, Inc., *Liquid Sampling for WM*, Revision 4, SMPL-02, Environmental Services Procedure, Fernald Closure Project, April 2004.

Fluor Fernald, Inc., *Water Sample Shipment*, Revision 3, PCN 1, ADM-03, Environmental Monitoring Project Procedure, Fernald Closure Project, May 2002.

U.S. Department of Energy (DOE), *Integrated Environmental Monitoring Plan*, Revision 3, Final, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, 2003.

U.S. Department of Energy (DOE), *PSP for On-Site Disposal Facility Monitoring Program, Variances 5, 6, 8, 9, and 10*, 20100-PSP-0001, for Revision 6 of the Project-Specific Plan for the On-Site Disposal Facility Monitoring Program, Fluor Fernald, Inc., DOE Fernald Area Office, Fernald, OH 2002 through 2004.

U.S. Department of Energy (DOE), *Sitewide CERCLA Quality Assurance Project Plan*, Revision 3, FD-1000, Fernald Environmental Management Project, DOE Fernald Area Office, Fernald, OH, November 2003.

U.S. Environmental Protection Agency (EPA), *Methods for Chemical Analysis of Water and Wastes*, EPA600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, OH, March 1983.

U.S. Environmental Protection Agency (EPA), *Superfund Analytical Services Contract Laboratory Program/Statement of Work, Multi-Media, Multi-Concentration Inorganics Analysis*, ILM05.3, March 2004.

U.S. Environmental Protection Agency (EPA), *Superfund Analytical Services Contract Laboratory Program/Statement of Work, Multi-Media, Multi-Concentration Organics Analysis*, OLM04.3, March 2003.

U.S. Environmental Protection Agency (EPA), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd edition, Office of Solid Waste, Washington, D.C., April 1998.

APPENDIX C

FERNALD CLOSURE PROJECT DATA QUALITY OBJECTIVES, MONITORING PROGRAM FOR THE ON-SITE DISPOSAL FACILITY

FERNALD CLOSURE PROJECT

DATA QUALITY OBJECTIVES

Title: Monitoring Program for the On-Site Disposal Facility

Number: GW-024

Revision: 6

Effective Date: June 23, 2004

Contact Name: William Hertel

APPROVALS:

J. E. Chambers ______________________ Date: 6/23/04

James Chambers
DQO Coordinator

William C. Hertel ______________________ Date: 6/23/04

William Hertel
Hydrogeology

RECORDS OF ISSUES AND REVISIONS

Rev. #	0	1	2	3	4	5	6
Effective Date:	3/27/97	3/31/97	5/12/97	7/24/97	5/28/98	1/28/00	6/23/04

DATA QUALITY OBJECTIVES
On-Site Disposal Facility Monitoring Program

1.0 STATEMENT OF PROBLEM

Problem Statement: Analytical data, obtained from a multi-component monitoring system, is necessary to support the leak detection element of the On-Site Disposal Facility (OSDF) monitoring strategy.

The Records of Decision for Operable Units 2, 3 and 5 (OU2, OU3, and OU5 ROD) include the construction of an OSDF for long-term storage and containment of low-level radioactive waste. The construction of the OSDF is being completed in phases with eight individual cells and a ninth contingency cell. Each cell will be monitored on an individual basis for leak detection and possible environmental impact.

A major concern regarding the storage of waste at the Fernald site is the prevention of any additional environmental impact to the Great Miami Aquifer (GMA). To address this concern, site-specific monitoring requirements that integrate state and federal regulatory requirements were developed to provide a comprehensive program for monitoring the ongoing performance and integrity of the OSDF.

In consideration of unique hydrogeological conditions and pre-existing contamination on-site, a baseline data set (Ohio Administrative Code (OAC) 3745-27-10(D)(5)(a)(ii)(*a*); 3745-27-10(A)(2)(b) and OAC 3745-54-97(G)) will be established. In addition, an alternate sampling program (OAC 3745-27-10(D)(5)(a)(ii)(b) and (b)(ii)(b); 3745-27-10(D)(6)) will be initiated to address site-specific complexities, provide an effective monitoring program for the OSDF that meets and exceeds federal and state regulations for Treatment, Storage, and Disposal (TSD) facilities.

The OSDF monitoring program strategy utilizes OSDF system design in combination with a monitoring well network to provide data for a collective assessment of OSDF performance.

Each individual OSDF cell is constructed with a leachate collection system (LCS) and leak detection system (LDS); these systems are separate and contain sample collection points within the valve house. The LCS is designed to collect infiltrating rainwater (and storm water runoff during waste placement) and prevent it from entering the underlying environment; the leachate drainage layer drains to the west through an exit point in the liner to leachate transmission system located on the west side of the OSDF. From there, the leachate flows by gravity to a lift station and is currently pumped to the Fernald site's Bio-Surge Lagoon for subsequent treatment at the AWWT facility. The LDS is a drainage layer positioned beneath the primary composite liner; any collected fluids from that layer drain to the west where they are removed and routed for treatment as in the LCS. Flow monitoring measurements of the LCS and LDS will be conducted on a scheduled basis. Monitoring the flow and sampling of the LCS and LDS liquids will provide an assessment of migratory dynamics within each cell and determine primary liner performance.

[Note that the current site plans are for AWWT to be reduced in both size and capacity, referred to as the converted AWWT (CAWWT). With the scheduled permanent shut-down of the Bio-Surge Lagoon in November 2004, leachate will be redirected to the storm water retention basin (SWRB). During the conversion process of the AWWT facility, leachate collected in the SWRB will be routed for treatment in the AWWT. When the CAWWT is operational in February 2005, the leachate collected in the SWRB will be routed to the new CAWWT facility. Leachate will be managed in this manner until October 2005 when the SWRB is removed from service to support soil remediation in the SWRB footprint. At that time, leachate will be routed directly to the CAWWT facility for treatment.]

The monitoring well network consists of two separate systems. A horizontal till well is placed in the subsurface beneath the LCS and LDS liner penetration box within each cell. Each liner penetration box represents the lowest elevational area of each cell, by definition the most likely location for a potential leak to migrate. GMA monitoring wells are placed at the immediate boundaries of each cell, at upgradient and downgradient locations, to monitor the water quality of the aquifer and verify presence/absence of environmental impact.

Sampling of the four components mentioned above (LCS, LDS, horizontal till well, and GMA monitoring wells) will provide a four-layered holistic approach to provide early leak detection from the OSDF.

2.0 IDENTIFY THE DECISION

Analytical data provided by a monitoring program will provide the information necessary for management of the OSDF. Information derived from flow volume assessment and sample analyses will constitute the first tier of a three-tier strategy: detection, assessment, and corrective action; if it is determined from detection monitoring that a leachate leak from the OSDF has occurred, additional groundwater quality assessment studies will be initiated and corrective action monitoring plans will be developed and implemented as necessary. If the detection monitoring continues to successfully demonstrate that the performance of the OSDF is as designed, then the monitoring program will remain in the first-tier detection mode and the need for a follow-up groundwater quality assessment and/or corrective action monitoring plans will not be necessary.

OSDF monitoring strategy includes the establishment of baseline conditions in the hydrogeological environment beneath each individual cell prior to waste placement. Both perched groundwater and the GMA contain uranium and other Fernald site-related constituents at levels above background in the vicinity of the OSDF, therefore, it is necessary to establish pre-existing conditions (constituent concentration levels and variability) for applicable OSDF monitoring parameters. Actual existing baseline values will ensure accurate assessment of data trends during active cell operations and the interim prior to long-term post-closure.

3.0 INPUTS THAT AFFECT THE DECISION

An extensive characterization of wastes, to quantify environmental contamination in the area of the Fernald site provided the information to develop the Waste Acceptance Criteria (WAC) for waste entering into the OSDF. The leachability, mobility, persistence, toxicity, and stability of identified waste constituents were evaluated, and of 93 constituents, 16 were identified as having the potential to impact the aquifer within a 1000-year performance period. The 16 site-specific leak detection indicator parameters chosen as monitoring parameters will be supplemented with 4 water chemistry indicator parameters and a field analysis of water quality.

Additionally, waste treatment, storage and disposal facilities (TSD) must analyze collected leachate on an annual basis to fulfill a reporting requirement per Ohio Solid Waste regulation, Ohio Administrative Code (OAC) 3745-27-19(M)(5)). OSDF monitoring will comply by collecting a grab sample yearly and performing analysis for the parameters listed in Appendix I of OAC 3745-27-10 and polychlorinated biphenyls (PCBs).

Although the site-specific leak detection indicator parameter list was initially created for the purpose of establishing baseline, it will probably provide sufficient and reliable data for the monitoring throughout the active operation of the OSDF, however, future considerations for potential modifications of the parameter list may occur during subsequent re-evaluations of the monitoring program.

Monitoring of the liquid flow within the LCS and LDS drainage layers will be performed to provide a trend analysis that can be used as an indicator of containment system performance; changes in the trend of flow will initiate follow-up inspection and corrective action measures as necessary. A graded approach, patterned after federal hazardous waste landfill regulations 40 CFR 264.303(c)(2) and Ohio solid waste rule OAC 3745-27-19(M)(4), will be utilized to provide a quantitative monitoring control for drainage within the OSDF.

4.0 DEFINE THE BOUNDARIES OF THE STUDY

Subsurface conditions in the immediate area of the OSDF location are typical of glacial deposition; the subsurface formation is comprised of a glacial till, underlain by sand and gravel deposits which are characterized as the GMA. The GMA is a high-yield aquifer and a designated sole source aquifer under the Safe Drinking Water Act (SDWA). It supplies a significant amount of potable water for private and industrial use in Butler and Hamilton counties (Ohio); therefore, a leakage of contaminants from the OSDF could affect water quality for a large population.

Typically a detection monitoring program consists of upgradient and downgradient monitoring well installations with routine sampling for a prescribed list of parameters, consequently, detection of a statistically significant difference in downgradient water quality will indicate that release from a facility may have occurred. However, at the Fernald site, low permeability and pre-existing contamination within the overburden formation, and implementation of a site-wide groundwater remedial action for the subsurface aquifer formation, add complexity to the development of a groundwater detection monitoring program that is consistent to the standard approach in solid and hazardous waste regulations. To accommodate such complexities, federal and state regulations do allow alternative monitoring strategies, which provide flexibility with respect to well placement, statistical evaluation of data, parameter lists, and sampling frequency. The OSDF monitoring program does incorporate an appropriate alternative monitoring strategy to ensure integrity and provide effective early warning of a leak from the facility. The program includes alternate well placement, statistical analysis, parameter lists, and sampling frequencies.

An OSDF leak would migrate vertically towards the GMA beneath it; therefore, a horizontally positioned well placed within the glacial till shall have its screen interval beneath the LCS and LDS liner penetration box of each cell as a site-specific approach to monitor a first-entry leakage from the OSDF. The GMA wells are installed immediately adjacent to the OSDF, just outside the boundary of the final composite cap configuration. Each cell will be monitored with a set of GMA monitoring wells, placed upgradient and downgradient of each cell. The OSDF will be bordered by a network of GMA monitoring wells that provide upgradient and downgradient monitoring points for the entire facility.

The parameters are limited to those indicated as having a potential to migrate from the OSDF and impact the GMA. The concentration levels of concern are those required to determine fluctuations in GMA concentrations and provide a sensitivity great enough to indicate potential impacts.

Sampling frequencies for the OSDF monitoring program meet federal and state requirements. The additional data will be used to develop an appropriate statistical procedure and to compensate for the varying temporal conditions in the groundwater flow direction and chemistry due to seasonal fluctuations.

5.0 DECISION RULE

The initial flow and water quality data obtained from the LCS, LDS, and the groundwater monitoring components, will be used to begin a statistical trend analysis of the volume of leachate produced by each cell and the corresponding concentrations of analytes in each individual monitoring component. Each cell will be evaluated independently; therefore, the preferred method of statistical evaluation for the OSDF will be an intra-well trend analysis following establishment of baseline conditions in the glacial till and GMA. The intra-well trend analysis approach will be applied to data from all of the components - the LCS, LDS, and the groundwater monitoring wells. The data received from each component will be compared for evidence of consistent trend values that verify OSDF integrity status. Additionally, data shall also be compared between all of the monitoring components within the multi-component monitoring system of each cell. This strategy is the four-layer vertical slice/trend analysis approach.

Data collected from the OSDF monitoring program will also be used to supplement the compilation of data for the Integrated Environmental Monitoring Plan (IEMP). Groundwater data for those OSDF leak detection constituents that are also common to the IEMP groundwater remedy performance constituents will be utilized in the IEMP data interpretations as the data become available. Groundwater data collected for those unique OSDF leak detection constituents which are not being monitored by the IEMP groundwater monitoring program will be utilized only for the establishment of the OSDF baseline and subsequent leak detection monitoring. To provide an integrated approach to reporting OSDF monitoring data, the annual IEMP comprehensive annual environmental report will serve as the mechanism by which LCS and LDS volumes and concentrations will be reported, along with groundwater monitoring results, trending results, and interpretation of the data. Presenting data in one report will facilitate a qualitative assessment of the impact of the OSDF on the aquifer, as well as the operational characteristics of OSDF caps and liners. Additionally, the available monitoring data and interpretation of that data will be made available semiannually as part of the IEMP reporting process.

6.0 LIMITS ON UNCERTAINTY

In baseline establishment, the sensitivity and precision must be sufficient to define the GMA concentrations of the parameters of concern such that fluctuations will be observable, and effects impacting the Final Remediation Levels (FRLs) are observed. A false positive error would indicate that either certain parameters are present when in fact they are not, or that baseline parameters are present at higher concentrations than are actually present in the GMA. This type of error would give a false indication that the cell is leaking. A false negative error would indicate that certain parameters are not present when in fact they are. This may lead to a mistaken indication that the cell is not leaking. It is necessary to define the concentrations of the parameters of concern such that fluctuations in concentration and effects impacting the GMA will be observable.

Following baseline establishment, a false positive result in OSDF monitoring may suggest that a leak from the OSDF has occurred, when in fact, it has not. Additional monitoring assessments would be initiated in response and added costs would be incurred unnecessarily. The greater concern would be a false negative error, verifying that integrity of the OSDF was intact when in fact some component of the structure may have failed. No corrective action would be initiated and contaminants could migrate into the GMA undetected, possibly posing a threat to human health and the environment.

7.0 OPTIMIZE DESIGN

An aquifer simulation model (i.e., SWIFT and more recently VAM3D) was used to select monitoring well locations, typically one upgradient and one downgradient of each cell. These wells will be used in the detection monitoring program, as well as baseline establishment.

Standard statistical modeling studies indicate that data from a minimum of four independent sampling events are necessary to establish baseline values, however, for an improved comparative statistical analysis, more sampling events were chosen to ensure sufficient available data for baseline establishment for each GMA monitoring well location. Experience/technical knowledge gained from monitoring Cells 1 through 3 have indicated that it is necessary to collect baseline samples either monthly, bimonthly, or quarterly in order to have enough data to perform statistics on a standardized frequency dataset. The baseline frequency is selected to develop an appropriate statistical procedure, to address OSDF construction schedules, and to compensate for the varying temporal conditions in the groundwater flow direction and chemistry due to the remedial action and seasonal fluctuations.

To ensure consistency of method and an auditable sampling process, each sample will be collected per the Sitewide CERCLA Quality Assurance Plan (SCQ) for groundwater sample collection and the requirements specific to this program will be outlined in the Project Specific Plan (PSP), On-Site Disposal Facility Monitoring Program.

Laboratory QC requirements will be as specified in the SCQ, unless otherwise specified in the task order to the laboratory. One hundred percent of the data will undergo field and laboratory validation.

All chemical sample analyses will be performed at ASL C, except general water chemistry analyses which will always be ASL B and field water quality analyses, which will always be performed at ASL A. Radiological constituents will be analyzed at ASL D, unless ASL E is required to meet detection limits.

Method detection limits (MDLs) and highest allowable maximum detectable concentrations (HAMDCs) for parameters analyzed under this program are to be as low as reasonably achievable for samples collected to establish baseline conditions in the horizontal till wells and the Great Miami Aquifer monitoring wells. This is to ensure that the samples collected are capable of providing the necessary bracketing of the baseline conditions. Once cell-specific baseline conditions are established via statistical methods, detection limits for a particular constituent may be raised for that cell as warranted. Since the MDLs differ from the SCQ-specified MDLs, the ASL defaults to ASL E although other analytical and validation requirements will remain as specified for ASL/VSL D. Data from all chemical samples will be validated to a minimum of VSL D requirements or VSL B for general water chemistry analyses. The radiological analysis and validation will be conducted at ASL/VSL D. The radiological ASL D will default to ASL E when HAMDCs specified in the SCQ are not higher than the groundwater FRLs specified in the Operable Unit 5 Record of Decision.

All samples require field QC and will include trip blanks and field blanks as specified in the SCQ. Duplicates will be collected for each sampling round (sampling round is defined as one round of sample collection from various locations occurring within a short period of time, i.e., several days). Equipment rinsates will be performed when dedicated equipment is not available. One laboratory QC sample set shall be collected per each release of samples. Laboratory QC will include a method blank and a matrix spike for each analysis, as well as all other QC required per the method and SCQ.

If a well does not recharge sufficiently to collect specified volumes for all analytes or the LCS/LDS systems do not contain sufficient volume for a full suite of samples, parameters will be collected in the order of priority stated in the PSP.

Following baseline establishment, sampling of the four monitoring components (LCS, LDS, horizontal/perched and GMA wells) for each cell will follow a quarterly schedule for site-specific parameters. A yearly grab sample will be collected from the LCS for the parameters listed in Appendix I of OAC 3745-27-10 and PCBs. Sampling parameter requirements shall also be specified in the PSP.

Data Quality Objectives
Baseline Establishment for GMA Groundwater Monitoring of the OSDF

1.A. Task/Description: Baseline Establishment for GMA Groundwater Monitoring of OSDF. This sampling program will determine a baseline characterization of the GMA in the immediate vicinity of the OSDF.

1.B. Project Phase: (Put and X in the appropriate selection.)

RI ☐ FS ☐ RD ☒ RA ☐ R_VA ☐ OTHER ☐ Specify:

1.C. DQO No.: GW-024 DQO Reference No.: not applicable

---

2. Media Characterization: (Put an X in the appropriate selection.)

Air ☐ Biological ☐ Groundwater ☒ Sediment ☐ Soil ☐

Waste ☐ Wastewater ☐ Surface water ☐ Other (specify) Leachate

---

3. Data Use with Analytical Support Level (A-E): (Put an X in the appropriate Analytical Support Level selection(s) beside each applicable Data Use.)

Site Characterization

A ☒ B ☒ C ☒ D ☒ E ☒

Risk Assessment

A ☐ B ☐ C ☐ D ☐ E ☐

Evaluation of Alternatives

A ☐ B ☐ C ☐ D ☐ E ☐

Engineering Design

A ☐ B ☐ C ☐ D ☐ E ☐

Monitoring during remediation activities

A ☒ B ☒ C ☒ D ☒ E ☒

Other (Explain)

A ☐ B ☐ C ☐ D ☐ E ☐

4.A. Drivers: Operable Unit 2, 3, and 5 Record of Decision (ROD) and the Ohio Administrative Code for the containment of solid and hazardous waste , and the Code of Federal Regulations TSD Facility Standards.

4.B.Objective: To provide information by which verification of the ongoing performance and integrity of the OSDF and its impact on groundwater can be evaluated.

5. Site Information (Description): The Records of Decision for Operable Units 2, 3 and 5, include the construction of an On-Site Disposal Facility for long term storage and containment of low-level radioactive waste. The OSDF will consist of 8 or 9 individual cells and each cell will be monitored on an individual basis. The monitoring system developed to detect any potential leaks originating from the cells consists of

four components: a leachate detection system, a leak detection system, a till monitoring system, and a GMA monitoring system. This DQO addresses baseline characterization, facility, and ground water detection monitoring for the active cell phase of the OSDF.

6.A. Data Types with appropriate Analytical Support Level Equipment Selection and SCQ Reference: (Place an "X" to the right of the appropriate box or boxes selecting the type of analysis or analyses required. Then select the type of equipment to perform the analysis if appropriate. Please include a reference to the SCQ Section.)

1. pH ☒
   Temperature ☒
   Specific Conductance ☒
   Dissolved Oxygen ☒
   Turbidity ☒

2. Uranium ☐
   Full Radiologic ☒*
   Metals ☒*
   Cyanide ☐
   Silica ☐

3. BTX ☐
   TPH ☐
   Oil/Grease ☐

4. Cations ☐
   Anions ☐
   TOC ☒
   TCLP ☐
   CEC ☐
   COD ☐

5. VOA ☒*
   BNA ☒*
   Pesticides ☒*
   PCB ☒
   TOX ☒

6. Other (Specify) Total Alkalinity, Ammonia, Chloride, TDS, Sulfate, & Nitrate/Nitrite
   *See specific parameters listed in PSP.

6.B. Equipment Selection and SCQ Reference:

Equipment Selection	Refer to SCQ Section
ASL A ____________	SCQ Section: Appendix K (K.4.1)
ASL B ____________	SCQ Section: Appendix G
ASL C ____________	SCQ Section: Appendix G
ASL D ____________	SCQ Section: Appendix G
ASL E ____________	SCQ Section: Appendix G

7.A. Sampling Methods: (Put an X in the appropriate selection.)

Biased ☐ Composite ☐ Environmental ☐ Grab ☒ Grid ☐

Intrusive ☐ Non-Intrusive ☐ Phased ☐ Source ☐

Other (specify): ____________ DQO Number: DQO #GW-024

7.B. Sample Work Plan Reference: (List the samples required. Reference the work plan or sampling plan guiding the sampling activity, as appropriate.): Background samples and routine monitoring samples: PSP for On-site Disposal Monitoring Program, ECDC Document Number 20100-PSP-0001

7.C. Sample Collection Reference: (Please provide a specific reference to the SCQ Section and subsection guiding sampling collection procedures.) A PSP will detail sampling methodology; unless otherwise indicated in the PSP, sampling will follow requirement guidelines outlined in the SCQ, Appendix K, Section K.1 and K.4 Aqueous Sample Collection Method (Groundwater Sampling) and procedure SMPL-02 *Liquid Sampling for WM*

Sample Collection Reference: SCQ, Appendix K, K.1, K.4 ; Procedure SMPL-02 *Liquid Sampling for WM*

---

8. Quality Control Samples: (Place an "X" in the appropriate selection box.)

8.A. Field Quality Control Samples:

Trip Blanks	☒	Container Blanks	☐
Field Blanks	☒	Duplicate Samples	☒
Equipment Rinsate Samples	☒	Split Samples	☐
Preservative Blanks	☐	Performance Evaluation Samples	

Other (specify) none required

8.B. Laboratory Quality Control Samples:

Method Blank	☒	Matrix Duplicate/Replicate	☒
Matrix Spike	☒	Surrogate Spikes	☒

Other (specify) none required

9. Other: Please provide any other germane information that may impact the data quality or gathering of this particular objective, task or data use: